Aviation Week and Space Technology

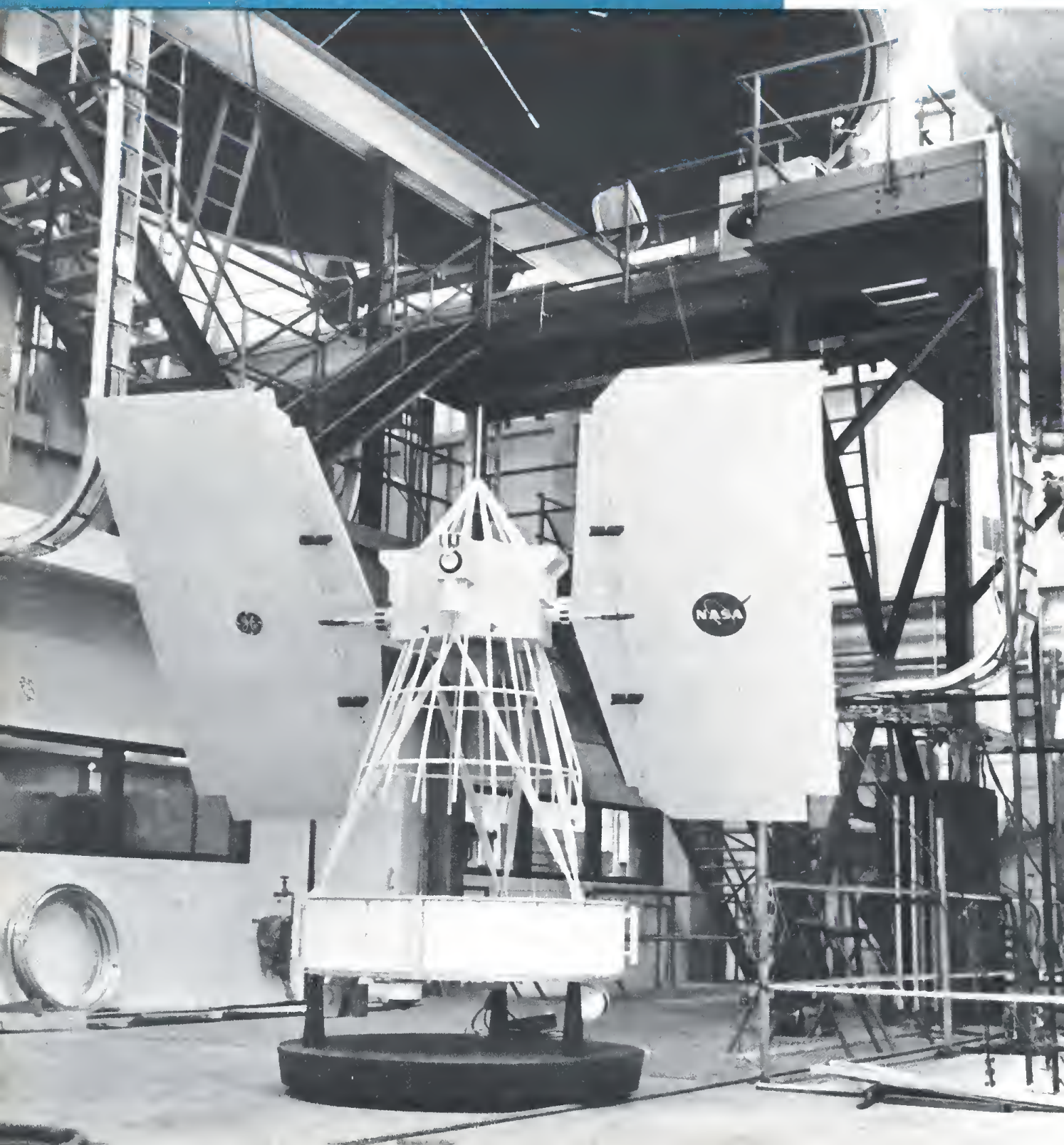
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January 22, 1962

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NASA/GE Nimbus Meteorological Satellite





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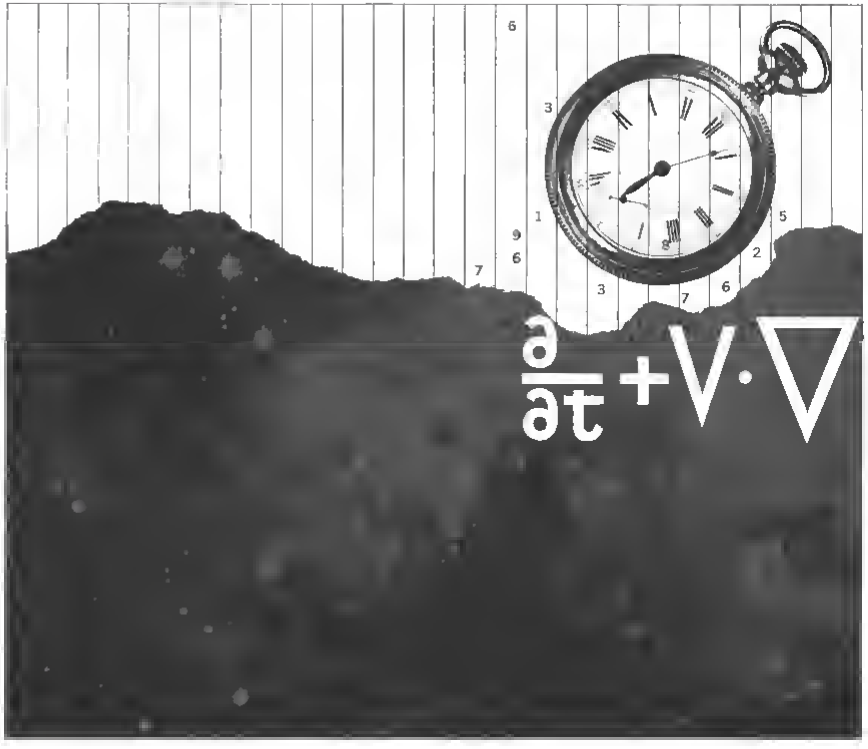
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AEROSPACE CALENDAR

Jan. 29—Army Aviation Contract Services Symposium, Hotel Washington, Washington, D.C. Sponsor: National Aeronautical Services Assn.

Jan. 29-30—Annual Meeting, Assn. of Local Transport Airlines, Washington Hotel, Washington, D.C.

Jan. 29-Feb. 2—American Institute of Electrical Engineers Winter General Meeting, Hotel Statler and Coliseum, New York.

Jan. 30-31—Board of Directors Meeting, Airport Operators Council International, Inn, Tampa, Fla.

Feb. 6-7—Symposium on Redundancy Techniques for Computing Systems, Department of the Interior Auditorium, Washington, D.C. Sponsor: Information Systems Branch, Office of Naval Research.

Feb. 7-9—Third Winter Convention on Military Electronics, IRE, Ambassador Hotel, Los Angeles.

Feb. 14-16—International Solid State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.

Feb. 15-17—Golden Gate Metals Conference, American Society for Metals, Fairmont Hotel, San Francisco, Calif.

Feb. 19-21—Tracking & Command of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco, Calif.

Feb. 22—First Women's Space Symposium, Ambassador Hotel, Los Angeles, Calif.

Feb. 27-Mar. 1—Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (unclassified)

(Continued on page 7)

AVIATION WEEK and Space Technology

January 22, 1962

Vol. 76, No. 4

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AEROSPACE CALENDAR

(Continued from page 5)

Gunter Hotel, San Antonio, Tex. Sponsors: South Texas Section Society for Nondestructive Testing; Southwest Research Institute.

Feb. 27-Mar. 1—Symposium on the Application of Switching Theory in Space Technology, Palo Alto, Calif. Sponsors: Lockheed Aircraft Corp.; Air Force Office of Scientific Research.

Mar. 1-3—Eighth Scintillation and Semiconductor Counter Symposium. IRE. Shoreham Hotel, Washington, D. C.

Mar. 5-8—Seventh Annual Gas Turbine Conference and Products Show, American Society of Mechanical Engineers. Shamrock Hilton Hotel, Houston, Tex.

Mar. 8-9—Institute of the Aerospace Sciences. Propulsion Meeting (classified). Cleveland, Ohio.

Mar. 14-16—Electric Propulsion Conference. American Rocket Society. Hotel Claremont, Berkeley, Calif.

Mar. 16—Annual Robert H. Goddard Memorial Symposium. Torques and Attitude Sensing in Satellites. American Astronautical Society. Washington.

Mar. 26-29—International Convention. Institute of Radio Engineers. Coliseum and Waldorf Astoria, New York.

Mar. 28-29—Third Symposium on Engineering Aspects of Magnetohydrodynamics. University of Rochester, Rochester, N. Y. Sponsors: American Institute of Electrical Engineers; Institute of the Aerospace Sciences; Institute of Radio Engineers; University of Rochester.

Apr. 1-4—Mid-Year Conference. Airport Operators Council. Shoreham Hotel, Washington, D. C.

Apr. 3-5—Launch Vehicles: Structures and Materials Conference. American Rocket Society. Ramada Inn, Phoenix, Ariz.

Apr. 3-6—National Aeronautic Meeting (including production forum). Society of Automotive Engineers. Hotel Commodore, New York, N. Y.

Apr. 10-12—Second Symposium on The Plasma Sheath—Its Effect Upon Reentry Communication and Detection. New England Mutual Hall, Boston. Sponsor: Air Cambridge Research Laboratories.

Apr. 11-13—Southwestern Conference and Electronics Show. Institute of Radio Engineers. Rice Hotel, Houston, Tex.

Apr. 11-13—Annual Technical Meeting and Equipment Exposition. Institute of Environmental Sciences. Sheraton Chicago Hotel, Chicago, Ill.

Apr. 14-16—Second Conference on Kinetics, Equilibria and Performance of High Temperature Systems. University of California, Los Angeles, Calif. Sponsor: Western States Section/Combustion Institute.

Apr. 16-18—Second International Flight Test Instrumentation Symposium. College of Aeronautics, Cranfield, England.

Apr. 16-18—Aerospace Systems Reliability Symposium. Institute of the Aerospace Sciences. Salt Lake City, Utah.

Apr. 24-26—Polytechnic Institute of Brooklyn's Symposium on the Mathematical Theory of Automata. United Engineering Center, New York, N. Y.

Apr. 25-29—Western Space Age Industries

(Continued on page 9)



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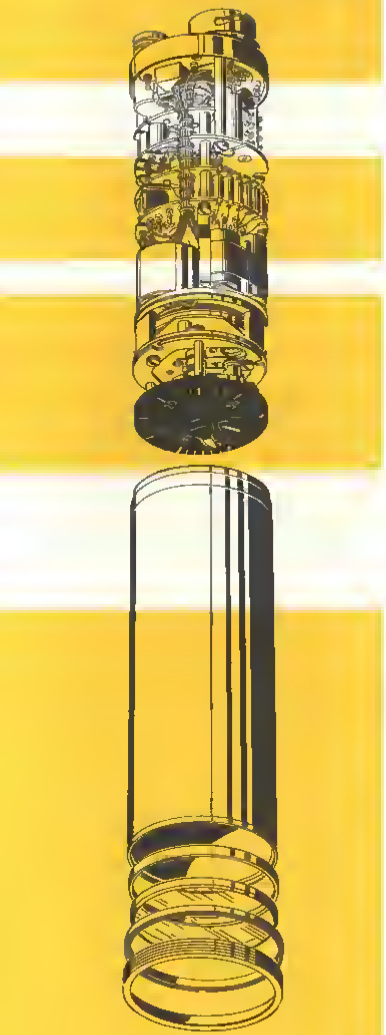
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AEROSPACE CALENDAR

(Continued from page 7)

and Engineering Exposition, Cow Palace, San Francisco, Calif.

Apr. 30-May 2—Meeting on Manned Space Flight, Institute of the Aerospace Sciences, Hotel Chase, St. Louis, Mo.

May 1-3—Spring Joint Computer Conference, Fairmont Hotel, San Francisco, Calif.

May 2-4—19th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 2-11—International Space Research and Technology Exhibition, Olympia, London, England. Sponsor: British Interplanetary Society.

May 3-4—First International Congress on Human Factors in Electronics, Institute of Radio Engineers, Lafayette Hotel, Long Beach, Calif.

May 7-9—Materials & Processing for Space Environments Symposium, Society of Aerospace Material and Process Engineers, Hotel Statler, St. Louis, Mo.

May 7-11—Annual Conference, Society of Photographic Scientists and Engineers, Somerset Hotel, Boston, Mass. Cosponsor: Air Force Cambridge Research Laboratories.

May 8-10—12th Annual Electronics Components Conference, Marriott Twin Bridges Motor Hotel, Washington, D. C.

May 14-16—National Aerospace Electronics Conference, Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

May 14-16—Joint Technical Society Department of Defense Symposium on Thermionic Power Conversion, Antlers Hotel, Colorado Springs, Colo.

May 14-17—21st Annual National Conference, Society of Aeronautical Weight Engineers, Benjamin Franklin Hotel, Seattle.

May 21-25—Eighth Aerospace Instrumentation Symposium and National Telemetering Conference, Sheraton Park Hotel, Washington, D. C.

May 22-24—Conference on Self Organizing Systems, Museum of Science and Industry, Chicago, Ill. Sponsors: Office of Naval Research, Armour Research Foundation.

May 22-24—National Microwave Theory & Techniques Symposium, Institute of Radio Engineers, Boulder, Colo.

May 24-26—Seventh Region Conference on Space Communications, Institute of Radio Engineers, Seattle, Wash.

June 6-7—Symposium on Standards for Filament Wound Reinforced Plastics, Naval Ordnance Laboratory, Silver Spring, Md. Sponsors: U. S. Navy, American Society for Testing and Materials.

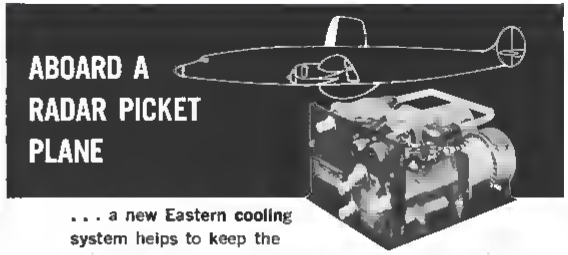
June 8-9—13th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

June 13-15—Annual Meeting, Heat Transfer and Fluid Mechanics Institute, University of Washington, Seattle, Wash.

June 19-21—39th Meeting, Aviation Distributors and Manufacturers Assn., Ambassador Hotel, Los Angeles.

June 19-22—Summer Meeting, Institute of the Aerospace Sciences, Ambassador Hotel, Los Angeles, Calif.

June 25-27—Sixth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.



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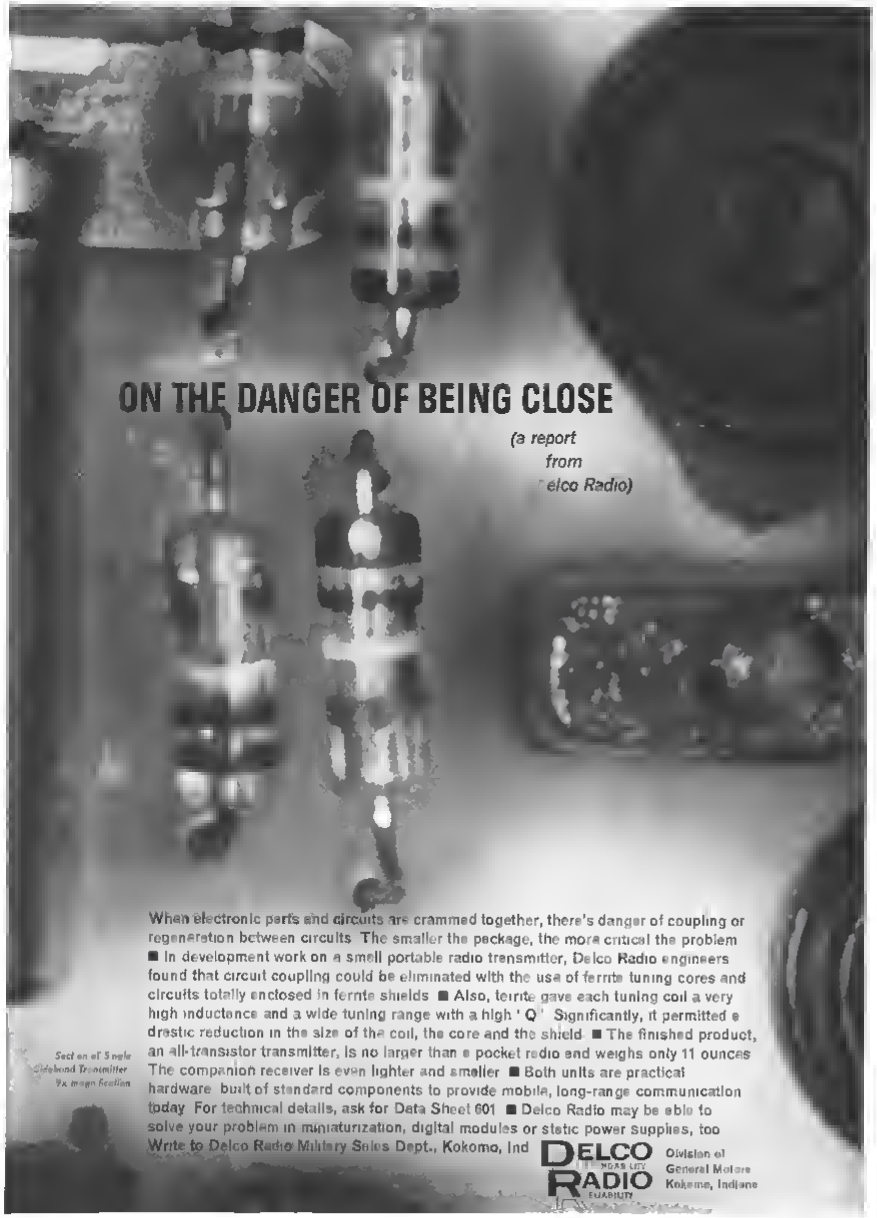
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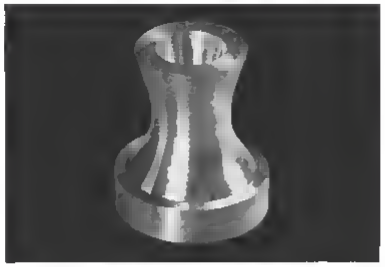
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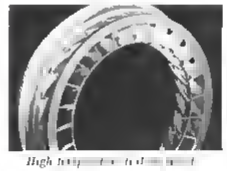
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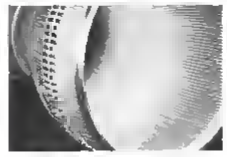
ENGINEERED BRAZING, developed by Solar, is a new concept in the fabrication and joining of highly critical metal products. The concept involves integration of research, engineering and manufacturing personnel into a highly skilled team of brazing specialists. Brazing facilities at Solar meet almost every current requirement. The heart of the *engineered brazing* concept is the use of these fabrication specialists in the early stages of product design.

PROVEN ADVANTAGES of *engineered brazing* are seen in the development and production at Solar of large liquid-cooled rocket engines, heat exchangers, gas turbine components, lightweight sandwich structures, electronic components and nuclear fuel elements and controls. Hundreds of feet of stainless steel tubing used in the construction of liquid-fueled rocket thrust chambers are brazed together in one simple cycle. Quality of the units is controlled in design, component manufacturing, and lay up stages. Actual production of the assembly then becomes the simplest operation of the entire program.



High [illegible]

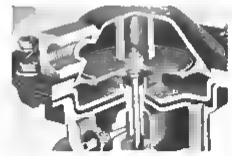
DESIGN IMPROVEMENT is a fundamental objective of *engineered brazing*. Solar research and development now make it possible to join dissimilar metals, non-metals to metals, cast to wrought metals of different thicknesses with a strong metallurgical bond. Protective metal coating or cladding is also preserved in the brazing process. These factors enable engineers to incorporate many of the heretofore difficult-to fabricate materials into designs for higher strengths and lower weights. Brazing also simplifies joining light gauge materials such as the .001 in stainless steel used in Solar honeycomb sandwich structures. Neither joint area nor length is a problem in brazing.



Liquid rocket thrust chamber

One of the many useful fabrication techniques developed at Solar is multiple brazing of complex assemblies. In this process, two, three or more parts of an assembly are added in separate brazing cycles. In each cycle, atomic diffusion of the braze material with the parent material produces an alloy with a higher melting point than the brazing temperature. Previous braze joints remain firm and solid as each succeeding joint is brazed.

COST SAVING is especially impressive when brazing advantages are incorporated in the original design. Brazing lends itself very well to automation and belt-line production. Uniformity of heat reduces problems of distortion and eliminates the need for stress reduction heat treat. In some cases assemblies can be heat treated during the regular brazing cycle. And in brazing, all joints of a complex assembly may be bonded simultaneously in one operation.



Multiple-brazed pneumatic control

METALLURGICAL EXPERIENCE at Solar covers more than 30 years of research, engineering and manufacture of highly critical assemblies. Solar has developed a family of brazing alloys with high strength properties at temperatures of 1800F and above.

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FOR ADDITIONAL INFORMATION about *engineered brazing*, write to Department J-197, Solar, San Diego 12, California.

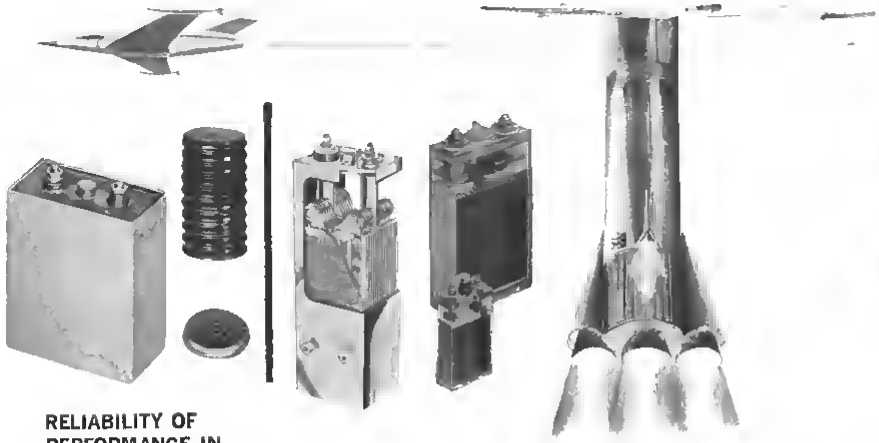
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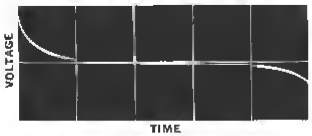
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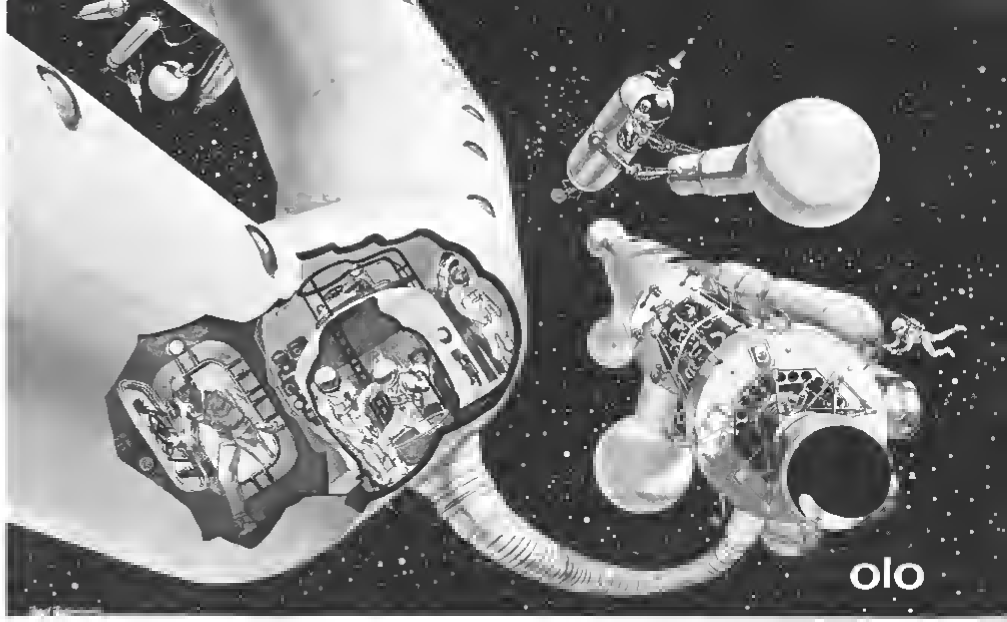
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Orbital Launch Operations will call for the highest systems capabilities the nation can muster, in virtually every technology known. A space station must be orbited, piece by piece, with crews and their subsistence complex to assemble and man it—followed by a scientific laboratory that will become the launch facility in orbit, where the parts of the orbital launch vehicle then will be assembled. Such Sperry capabilities as rendezvous guidance, stabilization, deep space radar tracking, injection, command controls, data handling, optical communications, navigation and recovery systems—all are being applied to OLO programs.

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ride for a B-52... VICKERS hydrostatic drives assist positive traction on icy airstrips

Ground handling the massive B-52 on icy airstrips demands positive, high torque traction and ultra-fine control. The B-52 Towing Tug, developed and produced by Air Logistics Corporation, achieves this optimum performance utilizing Vickers' hydrostatic drives.

Driven to the B-52 under its own power, the vehicle locks onto the aircraft's landing gear. Inflated tubes form a friction-surface contact with the landing wheel hubs. The towing vehicle's driving wheels are then retracted and four Vickers' hydraulic motors (one per landing wheel) drive the B-52's wheels pushing the vehicle ahead of it. Maximum traction thus is obtained utilizing the aircraft's own weight.

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COVER—Nimbus meteorological satellite, under development for the National Aeronautics and Space Administration by General Electric's Missile and Space Vehicle Dept. and Radio Corp. of America, tests on floor of new GE space technology center at Valley Forge, Pa. Nimbus will provide continuous weather coverage of the earth from a polar 600 nautical mile orbit.

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This is a new warning system designed by Northrop

Northrop has developed an automatic voice warning system for aircraft crews which gets action 4 times as fast as the traditional red lights. Called VIPS for Voice Interruption Priority System, it uses a female voice, speaking directly over the pilot's headset, to describe the exact nature of the hazard.

In recent tests, proficient pilots reacted to warning lights in an average of 12 seconds and some lights went unnoticed up to half an hour. With VIPS, the average time was just 3 seconds, *and no warnings went unnoticed.*

With VIPS, the pilot doesn't have to watch for warnings, nor figure out what they mean. The voice can be programmed to suggest remedial action. If several things go wrong at once, a logic network will select the most important and interrupt any lower priority warning.

VIPS was conceived, designed and developed to its present high degree of versatility by the Nortronics Division of Northrop. VIPS will be installed in all Air Force/General Dynamics B-58 Hustlers.

NORTHROP

First Look at the Budget

The annual federal budget is a massive document—a two volume affair with the initial book containing 368 pages and the appendix 1,171 pages. This is supplemented by batches of additional tables issued by Defense Department, National Aeronautics and Space Administration and others offering further details on the agencies' fiscal hopes and fears. It will take even the most avid student of these fiscal texts some weeks to fully digest their significance in detail, and Congress will spend a major portion of its next few months in study and debate on individual sections of this budget.

However, as a result of an initial study of the budget supplemented by more detailed briefings on their specific segments by Defense Department and NASA officials, it is possible to form some early impressions of the general direction and import of this Fiscal 1963 budget—the first full-scale budget exercise of the Kennedy Administration.

In the aerospace field, it is basically a positive budget. It appears to be aimed at doing things rather than explaining why it isn't really necessary to do so many things that are inevitably extremely expensive. Biggest impact of this philosophy appears in the space budget primarily in the NASA appropriation but also in less identifiable form in the defense budget proposals. The combined total for space technology in both NASA and Defense Department is about $5 billion.

If 1961 is to go down in history as the year this nation decided to run a space race with the Soviet Union in earnest, then it appears from the budget that 1963 will be the year when the first evidence should appear that we have not only maintained the pace in this race, but that our rate of technical progress has accelerated beyond that of our chief competitor. For if there is any message in the Fiscal 1963 space budget, it is that the Kennedy Administration is backing its 1961 decision to accept the Soviet space challenge with the investment that must be made to achieve the goal of leadership in this field.

Determination Now Displayed

For several years during the sad, post-Sputnik years when this country's national leadership shrank from entering the space race, we editorialized that this nation had the scientific, industrial and fiscal resources to become the international leader in this field and that all that was really lacking was the determination of our leaders to run the race with the real intent to win it. Now it appears we have both this determination and the fiscal backing it requires and we predict that the international position of this nation in space technology will undergo a marked improvement during the next few years.

With the Fiscal 1963 budget devoting over $2 billion to manned space flight it is difficult to recall that just a year ago the last Fiscal 1962 budget proffered by the outgoing administration planned only for the completion of the Mercury orbital flight program and cautioned the nation to "wait and see" before pushing on with Apollo or any bolder space ventures.

While the new budget presages a rising temperature of enthusiasm for space technology in the scientific and industrial community, we must not forget that the space race is not a 100-yd. dash with early laurels for a quick outpouring of energy. We must remember that it is a marathon that will be punctuated with experimental failures and vexing disappointments, but must be run hard and long until its ultimate goal is achieved.

The defense budget contains few surprises. It follows the pattern, established by the Kennedy Administration during its first year in office, of pushing the establishment of a solid-fueled ICBM arsenal with the hardened Minuteman and the submarine-based Polaris, while placing its main emphasis on the buildup of forces required for limited wars and suppression of political infiltration by guerilla operations. It presages a military budget plateau of about $52 billion for the next three years.

Debatable Decisions

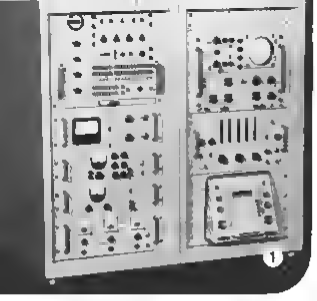
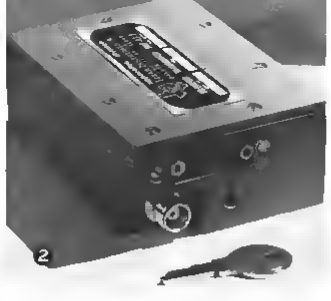
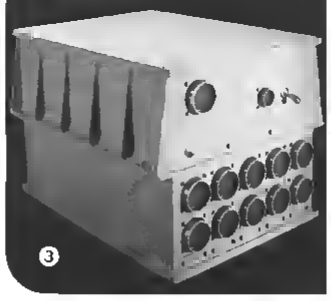
It also reflects the sharp line that is being drawn in the decision making level in the Pentagon between the development cycle for new weapon systems and the determination to put them into production for operational deployment with combat forces. One of the major cost-boosting items in the prior Pentagon budgeting process has been the lack of firm decisions at this point in the development cycle of new weapon systems. There will certainly be considerable debate about the wisdom of some of these decisions now being made. But few who have had any Pentagon experience in the past decade will question the need for sharp decisions at this point. The Nike Zeus, the B-70 Mach 3 bomber and the Dyna-Soar are all examples of new weapon systems that did not clear this hurdle in the Fiscal 1963 budget.

If there is any major weakness in the new military budget, we would spot it as the attitude in which the qualitative improvement of strategic retaliatory forces is being viewed. Certainly the continued deployment of Polaris and Minuteman is sound. But grave doubts are certain to appear over the lack of versatility and flexibility of the retaliatory forces if an ICBM warhead is the sole delivery method.

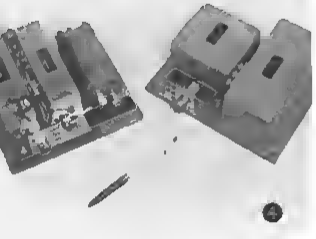
There is also a whiff of the old and long-discredited theory of the "minimum deterrent" in the current Pentagon thinking. Top Defense officials are trying to measure the amount of deterrent that is adequate with a precision that is humanly impossible to really achieve. If they are peddling this line solely for congressional consumption, they may get nothing more than some sharp reaction. But if they really believe it the country had better look out. This is an area that bears close watching as the budget debate unfolds.

For the aerospace industry, the Fiscal 1963 budget indicates a growing market and also severe technical and economic challenges from its government customers. Contrary to what many predicted, the manned aircraft business is far from finished with the coming fiscal year's procurement funds about equally divided between aircraft, missiles and space technology.

—Robert Hotz

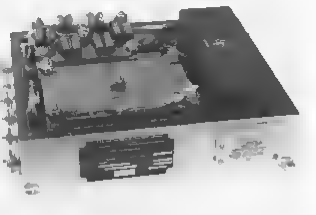




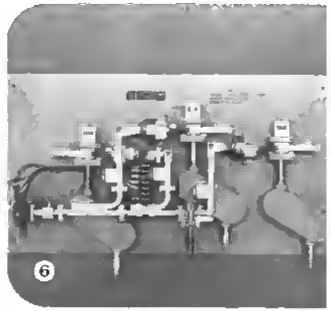
HERE'S HOW TI SOLVES SPACE COMMAND/GUIDANCE PROBLEMS

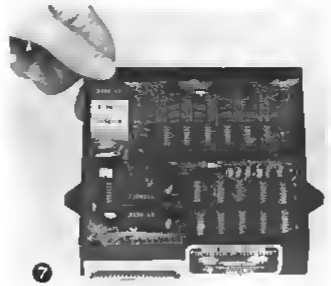


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3 Flight Data Encoder uses high/low level PCM telemetry system with ±0 5% accuracy, nulled-out drift A similar 70 channel system has been supplied to Jet Propulsion Laboratory for Mariner A
4 Solid State UHF Beacon Transponder made possible missile tracking by MIT Lincoln Laboratories Millstone radar
5 Digital flight controller/programmer in Douglas Aircraft's Delta Launch vehicle helped orbit NASA weather satellites Tiros II and III, communication satellite Echo I space probes Explorer X and XII
6 3 Channel Parametric Amplifier—Low noise operation for C-Band monopulse satellite tracker for Bell Telephone Laboratories
7. Digital Command Decoder for Ranger 3 5 lunar probes







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WHO'S WHERE

In the Front Office

Neil E. Firestone, formerly general manager of General Electric Co.'s Flight Propulsion Division, elected vice president manufacturing of International Telephone and Telegraph Corp., New York, N. Y.

Dugald Black, vice president for international operations. The Bendix Corp., with offices in New York City.

Lockheed Aircraft International Los Angeles, Calif., has elected **William B. Rieke** as vice president of the company's newly created General Aviation Division responsible for engineering, manufacturing and sales of the fireplace Lockheed 60 utility aircraft (AW Jan. 15, p. 23). Also, **T. A. McDougall,** program manager for the project.

Frank H. Erdman, president and a director of General Devices, Inc., Princeton, N. J.

Dr. Dana Young, technical vice president, Southwest Research Institute, San Antonio.

Paul A. Johnston, vice president for contracts administration, Aerospace Division, Martin Marietta Corp., Baltimore, Md.

William F. Gates, president, Dalmo Victor Co., Belmont, Calif., a division of Textron, Inc., succeeding **T. F. Moseley,** the founder of Dalmo Victor who will continue with the company.

Simmonds Precision Products, Inc., Tarrytown, N. Y., has elected the following as vice presidents: **Harrison Edwards** for manufacturing, **Alex Hossack** for engineering, **George Lascombes** for finance.

K. A. Waldron, vice president, marketing, IXR Danbury, Conn., the RF Products and Microwave Division of Amphenol-Borg Electronics Corp.

Raytheon Co., Lexington, Mass., has announced the merger of its Aero/Weapons and Missile and Space Divisions and the appointment of Vice President **T. C. Wisenbaker** as manager of the enlarged Missile and Space Division. Also, **Mike W. Fowler,** assistant manager, technical; **John G. Stobo,** assistant manager, production.

Edgar A. Williams, vice president, Electronic Specialty Co., Los Angeles, Calif.

Joseph W. Lewis and **Earl C. Janson,** vice presidents, Beckman Instruments, Inc., Fullerton, Calif. Lewis will continue as manager of the Scientific and Process Instruments Division and Janson will continue to coordinate manufacturing programs.

Honors and Elections

Frank A. Glassow, chief development engineer of Hamilton Standard Division of United Aircraft Corp., has been elected chairman of the Aerospace Industries Assn.'s Electronic Equipment Technical Committee for 1962. **Dr. W. A. Hane,** chief scientist of The Boeing Co.'s Aero-Space Division, was elected vice chairman. Also, **George C. Pfaff,** chief structures engineer of Martin Marietta Corp.'s Orlando (Fla.) Division, has been elected chairman of AIA's Aerospace Research and Testing Committee for 1962. **E. P. Troeger,** chief of materials research and process engineering at Douglas Aircraft Co., was elected vice chairman.

(Continued on page 95)

INDUSTRY OBSERVER

► National Aeronautics and Space Administration is flying a manned, unpowered Rogallo wing paraglider to prepare for flight tests of an inflatable paraglider being designed by North American Aviation. This type of landing aid may be used on the Gemini two-man capsule and the three-man Apollo capsule. The vehicle was built by NASA's Flight Research Center and is being launched by automobile tow from Rogers Dry Lake, Calif. If these tests are successful, NASA may attempt to launch the glider by aircraft tow.

► Lockheed Aircraft Corp. and Short Bros. & Harland of Belfast submitted a VTOL version of the Lockheed F-104 Starfighter to NATO as a joint project, taking their former collaboration agreement a step further. The VTOL concept (AW Dec. 18, p. 75) stresses ease of retrofit to F-104s now being manufactured under license by Germany, Canada, The Netherlands, Belgium, Japan and Italy.

► USAF's Space Systems Division will ask soon for industry proposals for a planning study of an earth orbital defense system that would provide a defense from space against missile launch from an enemy orbital weapon system.

► NASA is considering a series of re-entry tests, to be called Project Fire, in which test models of capsules will be flown to an extreme altitude by an Atlas-Agena B vehicle and then propelled downward by a Hercules-Allegany X-254 rocket, which is the third stage of the Scout vehicle. Velocity of 37,000 fps., slightly higher than re-entry from a lunar mission, would result, producing data applicable to the Apollo capsule design.

► Douglas Aircraft Co. is designing a ground effect machine with its own funds and has tentative plans to test the vehicle in July. Douglas also has signed a final contract to build a GEM for the Maritime Administration under subcontract to Vehicle Research Corp. (AW Oct. 30, p. 72).

► Advanced research on short wave length camera tubes is being conducted by Westinghouse, Radio Corp. of America and General Electric for USAF Space Systems Division's technical development branch.

► Experimental rocket nozzles made of Elkonite—tungsten infiltrated with copper and silver—are being tested by Aerojet-General, North American Aviation's Rocketdyne Division, Ford Motor Co.'s Aeronutronic Division and Naval Ordnance Test Station, China Lake, Calif. Developed by P. R. Mallory & Co., the material is intended to eliminate need for liners in nozzles. It was developed for high voltage electrical contacts.

► Contract for integration and test of the Titan 3 vehicle may be issued to Martin Marietta's Denver Division before Feb. 1 by Air Force Systems Command's Space Systems Division. There is a possibility that early Titan 3s will be boosted with existing 100-in. dia. solid propellant motors before the 120-in. dia. units reach operational status.

► USAF is programing about $5 million through Fiscal 1963 for updating technical facilities and capabilities of the Aerospace Research Pilot School at Edwards AFB, Calif. Bulk of the funds will be used to build simulators and modify high performance aircraft to provide dynamic training in the handling of spacecraft.

► Decision is expected within two weeks in a competition among six avionic firms to supply modulators to Stanford University for the two-mile-long electron accelerator being built for Atomic Energy Commission. Accelerator pipe will be located in a trench in the hills near Stanford and will take six years to finish. Modulators will be located in "galleries" spaced at regular intervals along the pipe.

► Russia's 70 ton diesel passenger hailstuff, the "Rikett," which is supposed to develop a speed of 50 mph., is to begin cruising the Irtysh River between Pavlodar and Omsk this year. It was delivered to Pavlodar late last year.



GUIDANCE COMPUTER
for NASA'S CENTAUR

Sometime this year, CENTAUR will be spaceborne. Already, the projected uses of CENTAUR bear fascinating implications for the future. . . placing a satellite in an orbit so exacting that it will remain in one spot over the earth's surface... soft landings on lunar and planetary bodies... timed launchings of several satellites from a single vehicle. Several major guidance functions will be performed in CENTAUR by a compact digital computer system from Librascope. It weighs 62 pounds, occupies little more than ¾ cubic foot. A note to Librascope outlining your control problems will bring a prompt answer from the country's most versatile manufacturer of computer control systems.

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GENERAL PRECISION

Washington Roundup

Merger Discussions

Merger talks within the airline industry are continuing with no noticeable decline in intensity. Chances now are strong that the Civil Aeronautics Board, which has encouraged such talks (see p. 41), will approve the proposed Continental-National merger quickly. However, mergers now being considered by larger carriers such as American and Eastern will be scrutinized carefully and may not receive the blessings that past Board statements have implied.

General Dynamics officials have discussed possible merger with Litton Industries to broaden the electronics capability and to bring C. B. Thornton into the company to head the combined operation. In the seven years since Litton was founded, Thornton has built it into a company grossing nearly $300 million annually, largely through the same pattern of acquiring outside companies that created General Dynamics. Most recent acquisition was the Ingalls Shipbuilding Corp. Litton is one of the few aerospace firms whose profits and sales have shown a continuous climb despite the recessions of 1957 and 1960.

AFSC-NASA Liaison

Maj. Gen. Osmond J. Ritland, commander of Air Force Systems Command's Space Systems Division, probably will be named chief Air Force representative in the AFSC-National Aeronautics and Space Administration liaison office (AW Jan. 8, p. 29). Gen. Ritland is assigned to the Pentagon for 90 days to prepare a staffing plan for the office, which has White House approval. If he is given the liaison post, Lt. Gen. Howell M. Estes, Jr., is expected to become Space Systems Division commander. SSD will continue to increase in importance. Estes' present job of deputy AFSC commander for aerospace systems would then be abolished. Present plan is to staff the liaison office with a unit for each NASA program in which USAF is interested.

Vice Adm. William F. Raborn, who has headed development of the Polaris submarine-launched missile system since it began six years ago, will relieve Vice Adm. John T. Hayward as deputy chief of naval operations for development. Adm. Hayward is scheduled for sea duty (AW Dec. 11, p. 25). Raborn will be replaced by Rear Adm. Ignatius J. Galantin, director of the submarine warfare division under the chief of naval operations.

Couriers for CIA

The 80-odd L-28 Helio Courier STOL aircraft being bought from the Air Force budgets for Fiscal 1962 and 1963 are not for liaison use at missile sites. They are intended for Central Intelligence Agency air missions where extended range at low altitude and ability to land in extremely small clearings are required. No decision has been made yet on what fixed-wing aircraft and/or helicopters will be used for the Air Force missile site job.

Defense and Labor Department officials are conferring with major government contracting agencies to determine if the policies now in effect regarding absorbing the cost of strikes can be improved. Assistant Defense Secretary Roswell Gilpatric said last week in the Administration's first policy statement on the matter that government will have to consider strike costs in negotiating the final price on incentive and several other types of contracts. The review arose because of costs incurred by the Pratt & Whitney Aircraft Division of United Aircraft Corp. in strikes at two plants in 1960.

Space Watchdog Unit

Watch for Chairman George P. Miller of the House space committee to establish a special investigating subcommittee similar to the one used by the House Armed Services Committee. Rep. Miller once was a member of the armed services subcommittee and apparently feels such a unit would be a valuable watchdog over the multi-billion dollar space program.

Sen. Kenneth Keating predicts the system for controlling the sale of strategic goods to the Sino-Soviet block will break down if Britain ignores U.S. protests and continues to sell such items as aircraft navigation equipment to Communist China. His prediction followed Britain's decision to sell six Vickers Viscounts, equipped with navigation gear made by a British subsidiary of a U.S. firm, in spite of State Department's objections. Sen. Keating said the British attitude could lead to collapse of the Coordinating Committee for International Control, which decides which goods should be withheld from Iron Curtain countries.

House space patents subcommittee will resume its hearings Jan. 29 with Justice Department and Patent Office witnesses scheduled to give their views on what form an overall federal patent policy should take.

James E. Webb, National Aeronautics and Space Administration chief, says rumors that he will resign to run for governor of Oklahoma "have no foundation in fact."

Washington Staff

Kennedy Asks $51.6 Billion for Defense

Fiscal 1963 request emphasizes limited war forces, is $8 billion higher than last Eisenhower budget.

By Larry Booda

Washington—President Kennedy last week asked Congress for $51 64 billion in new funds for the Defense Department for Fiscal 1963, a figure $8 billion higher than the Fiscal 1962 budget submitted by former President Eisenhower and $3 billion higher than the Fiscal 1962 budget after the Kennedy Administration had modified it Most of the increase is earmarked for programs intended to strengthen the nation's limited war potential

Defense expenditures for Fiscal 1963 are estimated to be $49 7 billion Force levels were set without regard for cost and planned for the missions rather than the military services in order to support U S foreign policy Defense Secretary Robert S McNamara was scheduled to present a 160-page statement on the requests to the Senate Armed Services Committee late last week

The entire federal budget as presented by the President estimates that expenditures in Fiscal 1963 will total $92 5 billion, an increase of $3 4 billion over Fiscal 1962, and receipts will total $93 billion, $10 9 billion more than in Fiscal 1962, producing a surplus of $0 5 billion New obligational authority requested from Congress is $99 3 billion

In terms of weapons, the emphasis in the Fiscal 1963 defense budget continues to be on the buildup of general purpose forces whose mission is limited conflict outside the U S, rather than on strategic retaliatory forces and the continental defense forces

It was indicated that requests for new defense money would remain near the Fiscal 1963 level for five years

The defense request is divided into $19 656 billion for the Air Force, $15 527 billion for the Navy, $12 196 billion for the Army, $2 12 billion for the Office of the Secretary of Defense, including independent defense agencies, $695 million for civil defense and $1 5 billion for military assistance. A sum of $220 million for personnel items will be requested in separate legislation, bringing the new obligational authority (NOA) request to $51 64 billion

Greatest buildup in aircraft strength for limited war use centers around the Navy-McDonnell F4H-1 fighter which is being bought in substantial numbers in both Fiscal 1962 and 1963 for both the Navy and the Air Force. Actual Fiscal 1963 fund requests for Navy models, the USAF tactical fighter version, called the F-110, and the USAF reconnaissance version, the RF 110 (Navy F4H-1P), will amount to $1 137 billion. If previously unprogramed USAF funds for Fiscal 1962 for the F-110 of $198 million are added, the new business in an 18 month period for McDonnell will amount to $1 335 billion The ratio of the fighter versions to reconnaissance versions is about 12 to 1 The money figures for the above aircraft and those that follow are for the delivered aircraft and include cost of government furnished equipment

New funds requested for research, development, test and evaluation amount to $6 843 billion, an increase of $560 million over Fiscal 1962 Expenditures in the same category are estimated to be $6 650 billion, an increase of $611 million In the operation and maintenance category, new money requested is $11 609 billion, a decrease from Fiscal 1962 of $261 million, while expenditures are expected to be $11 511 billion, a decrease of $84 million

Although the defense budget follows the traditional appropriations titles as required by law, a new financial summary by programs also was included (see box, p 27) Categories in this summary generally follow the program packages which were put together at the request of McNamara and Assistant Secretary of Defense (Comptroller) Charles J Hitch last year (AW Dec 25, p 14)

Presentation of the categories of the summary in terms of total obligational authority (TOA) without mentioning actual expenditures in past years and estimated spending for each category for the current and new fiscal years leaves room for erroneous interpretation

For instance, the TOA for Fiscal 1963 for the strategic retaliatory forces is shown as $9 361 billion The actual NOA request is somewhat less than this because $520 million for heavy bombers was impounded by McNamara Thus sum, and other carryovers are shown in total form under financing adjustments at the third line from the bottom of the summary Thus the actual NOA for strategic forces for Fiscal 1963 is less than for Fiscal 1962, which is shown below, right as $9 449 billion

Similarly, examination of the general purpose forces figures must take into account that the Kennedy Administration added a considerable amount of NOA for these forces for Fiscal 1962 much of which has carried over to Fiscal 1963

Principal defense requests are

- **An increase in Navy's Polaris** missile submarines This would bring the total fully funded to 35 A request for funds to buy long lead-time parts for six more submarines also is included Polaris system development and production NOA requested is $2 billion
- **An additional 200 USAF-Boeing** Minuteman solid propellant, silo launched missiles, enough for four squadrons This would make a total of 800 authorized for production Minuteman is scheduled to be operational in 1963 Funds requested for production will amount to $1 155 billion Another $1 billion is included for development
- **Acceleration of the USAF-Douglas** Skybolt air-launched ballistic missile program A total of $232 million is earmarked for procurement for test purposes in addition to a somewhat greater sum for development Skybolt is designed to be carried by B-52 heavy bombers, for launching at targets as far as 950 mi away
- **A backup system** involving onboard control of continental defense interceptor aircraft and missiles in the event that the Sage direction system is knocked out by a missile attack
- **Increase of five wings of USAF** tactical fighters from 16 to 21 An increase of two divisions in the regular Army from 14 to 16, allowing release of two National Guard divisions, and a 50% increase in Army weapons
- **An increase in the sealift** and airlift capability Most of the airlift was provided for in the Fiscal 1962 budget in the form of 15 Boeing C-135B jet aircraft, 10 Lockheed C-130B turboprop aircraft and more than 100 C-130Es New ship construction planned is 29, 33 others are scheduled for conversion

- **A conventionally powered** aircraft carrier

The Lockheed C-141 jet cargo transport is scheduled for production. The request for production funds is $208 million Development funds for the C-141 were $85 million in Fiscal 1962 and production funds were $14 million

Earlier reports that preproduction funds for long lead time items of the Army's Nike Zeus anti-missile missile had not been approved were confirmed It was explained that the system has limitations and until it is demonstrated that those limitations can be overcome, the system will remain in a development status

Development of the USAF North American B-70 supersonic bomber is limited to the $1 3 billion appropriated in past years for two flight demonstration prototypes and one flight vehicle with a bomb-navigation system installed No new money was requested

The budget request confirms the planned development of a medium range ballistic missile (MRBM) which will use solid-propellants and states that both mobile land and sea based versions are under consideration The MRBM is intended to fill the range from 1 000 mi to 2 200 mi

In the field of astronautics the budget states that development will

Aircraft-Missile Strength

	Actual June 30, 1961	Planned June 30, 1962	June 30 1963
Military forces:			
Air Force			
USAF combat wings	88	98	86
Strategic wings	37	37	33
Air defense wings	19	18	17
Tactical wings	32	43	36
USAF combat support flying forces	119	132	122
Air refueling squadrons	65	67	59
MATS air transport squadrons	21	30	26
Other specialized squadrons	33	35	37
Aircraft inventory—active	16,905	16,244	15,449
Navy			
Commissioned ships in fleet	819	898	862
Warships	375	395	383
Other	444	503	479
Attack carrier air groups	17	18	17
Carrier anti-submarine air groups	11	12	11
Patrol and warning squadrons	38	53	35
Marine divisions	3	3	3
Marine air wings	3	3	3
Aircraft inventory—active	8,793	9,297	8,950
Army			
Air defense anti-aircraft battalions	77	65	63
Surface to surface missile battalions	24	30	33
Helicopter aircraft inventory—active	2,721	2,785	3,039
Fixed-wing aircraft inventory—active	2,843	2,818	2,855

Major Military Obligations and Expenditures

(Millions of Dollars)

	N O A [r] FY 1961	Direct Obligations	Expend FY 1961 (Actual)	N O A FY 1962	Direct Obligations	Expend FY 1962 (Est.)	N O A FY 1963	Direct Obligations	Expend FY 1963 (Est.)
Air Force									
Aircraft procurement	3,267	3,804	3,926	3,723	4,242	4,178	3,135	3,827	3,460
Missile procurement	1,173	1,546	1,922	1,805	2,366	2,370	2,500	2,550	2,446
Navy									
Aircraft procurement	1,612	2,081	1,832	1,830	2,261	2,104	2,135	2,382	1,923
Ship procurement	2,246	2,207	1,801	2,938	2,410	2,049	2,982	2,866	2,308
Missile procurement	553	486	493	878	957	602	953	987	772
Army									
Aircraft procurement	119	160	141	243	248	167	218	218	185
Missile procurement	351	424	557	573	575	532	558	558	681

[r] New obligational authority

Financial Summary

FY1961, FY1962 and FY1963 Programs (TOA) NOA and Expenditures
(Millions of Dollars)

Programs	FY 1961 Budget (actual)	FY 1962 Original Budget Estimates (Jan 1961)	FY 1962 Current Budget Plan (Jan 1962)	FY 1963 Budget Estimates
Strategic retaliatory forces		7 468	9 449	9 361
Continental air and missile defense forces		2 309	2,207	2 052
General purpose forces		14 679	18 205	18 413
Sealift/airlift forces		816	1 117	1 293
Reserve and guard forces		1,632	1 845	1 868
Research and development		4 156	4 727	5 667
General support		11 625	12 131	12 803
Civil defense		45	256	695
Military assistance		1 800	1 600	1 500
Proposed legislation quarters allowance, military personnel per diem and retired pay		—	—	220
Total Obligational Authority	46 077	44 530	51 537	53 877
Deduct financing adjustments	3 001	845	1 659	2 237
New Obligational Authority	43 076[2]	43,685[3]	49 878	51 640

[1] Total Obligational Authority (TOA) used for the first time this year in the defense budget, represents New Obligational Authority for Fiscal 1963 plus unobligated balances carried over from previous fiscal years

[2] Excludes $30-million reappropriation to Wherry Act Housing Revolving Fund

[3] Includes adjustment for "Civil defense" shown in programs on a comparative basis.

Project Trump to Gather ICBM Infrared Data

Air Force officials at Eglin AFB, Fla., briefed industry last week on a forthcoming competition for an imaging infrared tracking radiometer that will be employed in a major infrared measurement program, Project Trump, from which the Air Force hopes to obtain invaluable data about infrared characteristics of ballistic missile launches.

The radiometer is expected to be capable of tracking radiation from rocket and missile exhausts and plumes in two overlapping infrared spectral regions covering windows between one and eight microns.

Air Force's Project Trump (Target Radiation Measurement Program) is similar in intent to the Advanced Research Projects Agency-Naval Ordnance Test Station program known as Tabstone (AW Jan. 8, p. 35; July 17, p. 77).

Both the Trump and Tabstone projects are designed to obtain necessary radiation background information needed by missile warning satellite systems like Midas in distinguishing between missile launches and background radiation. This information was to have been secured under Task 4 of the now defunct ARPA Air Force program Lofter (AW Aug. 14, p. 23) many ideas of which were reworked and will be carried out in Tabstone and Trump.

continue on the navigation satellite the communications satellite and on reconnaissance and early warning satellites. These are the Transit, Advent, Samos and Midas satellites. Investigation of problems of manned vehicles with orbital capabilities will continue.

As part of the national space booster program the Titan 3 solid and liquid propellant vehicle is being developed. Large solid-propellant boosters are also being investigated.

Funds are included for research in advanced water propulsion systems, hydrofoil vessels, sonar, catapults and arresting gear. Amphibious vehicles including "air cushion" or ground effect machines (GEM) are being developed.

USAF Missile Funds

As the USAF General Dynamics Atlas and USAF Martin Titan inter-continental ballistic missiles shift further into their operational phases funds for their procurement will decrease. Atlas is programed for $202 million, down from $620 million last year. Titan is scheduled for $416 million, down from $856 million.

No additional funds are provided for the USAF North American Hound Dog air to surface missile. A total of $145 million was appropriated in Fiscal 1962, which will assure production for another two years.

The Martin Bullpup air to ground troop support and interdiction missile will continue in production for the Air Force with another $31 million requested in addition to the $76 million of last year. Navy also is ordering the missile.

Also in the Air Force purchase is $24 million worth of Sidewinder air-to-air infrared homing missiles.

In the projected Air Force aircraft purchase are Boeing KC-135 and RC-135 four-engine jet tankers and reconnaissance aircraft with a total cost of $375 million.

The Republic F-105 tactical fighter purchase will be about half that of Fiscal 1962 at a cost of $158 million. Also included in the Air Force purchase are the Northrop T-38 supersonic jet trainer, the L-28 Helio Courier STOL aircraft, two unspecified helicopters, an aircraft for missile site and Texas Tower liaison and one Boeing 707 jetliner for the presidential special mission airlift. The total Air Force aircraft purchase is 795 aircraft. Air Force aircraft modifications are programed for $675 million.

Navy aircraft purchases, each of which is for more than $100 million, are for the F4H, the Lockheed P3V turboprop anti-submarine warfare aircraft, the North American A3J aircraft, the Grumman A2F-1 attack aircraft, the Douglas A4D attack aircraft, the Chance Vought F8U-2NE all weather fighter and the Grumman W2F-1 airborne aircraft control plane.

Completing the Navy purchase of 887 aircraft are the Boeing-Vertol HRB-1 helicopter, the Kaman HU2K helicopter, the Sikorsky HUS-2 helicopter, the North American T3J jet trainer (USAF T-39), the Grumman S2F-3 ASW carrier aircraft an unspecified helicopter and the Lockheed GV-1 turboprop aerial tanker and transport for the Marines. A sum of $60 million is earmarked for modification of Navy aircraft.

The Army aircraft program for Fiscal 1963 calls for the purchase of 582 aircraft. A total of $72 million will go for purchase of the Bell HU-1B turbine powered battlefield helicopter. An additional $24 million is programed for the de Havilland AC-1 STOL transport, while $48 million is requested for the Boeing-Vertol HC-1B tandem rotor heavy assault helicopter.

Rounding out the Army purchase will be an unspecified sum for the purchase of Bell H-13 and Hiller H-23 helicopters to fill the gap for a light liaison rotary wing aircraft until the new light observation helicopter (LOH) can be developed.

A total of 560 actions were taken by the Defense Department in the month before the budget was completed to reduce budget items that were non-combat in nature. One category which suffered was administrative aircraft. The North American T-39, the Lanchild T-27 and the Lockheed C-140 were eliminated from the USAF request and the Grumman Gulfstream was eliminated from the Navy request.

Although the package program system will be the key procedure in the formation of future defense budgets, there is no intention of asking Congress to change the budget format it is accustomed to working with.

Satellites Requested For Weather Bureau

Washington—U. S. Weather Bureau, largely through broader use of the Tiros and Nimbus meteorological satellites, hopes to add another dimension to forecasting in the coming fiscal year.

The Weather Bureau budget for Fiscal 1963 requests $45 million to buy, launch and operate two additional Nimbus satellites. The $48 million the bureau received in Fiscal 1962 for satellites will finance the initial two Nimbus satellites with the first of these slated to be launched in Calendar 1963.

Francis W. Reichelderfer, chief of the Weather Bureau, told Aviation Week the combination of Tiros satellites orbiting at a 47.8 deg. angle to the equator and the Nimbus satellites flying in a near polar orbit will give the bureau a global picture of what weather is brewing, thus making it easier to predict where the storms will strike. He said this combination of satellites will give the best indication to date of the true potential of these forecasting aids.

Weather Bureau officials originally planned to ask for $60 to $70 million to finance three Nimbus satellites in Fiscal 1963, but the formal request to the Budget Bureau was cut in two for economy reasons. However, there is still a good chance the National Aeronautics and Space Administration will finance the fifth Nimbus. Officials hope all five will be in orbit by the end of Calendar 1964.

Aside from the meteorological satellite money, which is carried in a separate account, the Weather Bureau asked Congress for $75.5 million to continue and expand existing programs. The request was split this way: $59.5 million for salaries and expenses, $11.5 million for research and development and $4.5 million for equipment.

Approximately half of the $4.5 million requested for equipment would be spent on aviation facilities.

NASA Fund Requests Total $3.9 Billion

By Edward H. Kolcum

Washington—President Kennedy's $3.9 billion request for National Aeronautics and Space Administration's Fiscal 1963 programs is regarded by the agency as the most important hurdle in the long-range civilian space program because it will provide the blown payment for critical long lead time hardware for the Apollo manned lunar landing program.

The President asked Congress for new NASA money totaling $3,943,276,000 including $156 million to supplement Fiscal 1962 funds, and remainder for the regular Fiscal 1963 appropriation (AW Jan. 8, p. 21). Heart of the new budget is manned space flight, with 68% directly earmarked for development of manned spacecraft, vehicles to launch them and facilities to support the program.

NASA has doubled its money requests annually since it was formed in 1958 (see chart p. 30). The agency foresees a further increase next year when its request will level at $5.86 billion. This level will be the annual request for the remainder of this decade, under present planning.

$50 Billion Program

If Congress approves the Fiscal 1963 request, the action will be taken with the understanding that the funds are part of a long-term program with an estimated total cost of $50 billion. But Fiscal 1963 is characterized as the year of great decision particularly for the manned lunar landing program, expected to cost at least $20 billion (AW June 5, p. 26).

NASA is expected to explain to Congress, in justifying its programs, that if a high level of space activity cannot be sustained, the full Fiscal 1963 request is not needed. However, this explanation probably will not be necessary, because both President Kennedy and Vice President Johnson are backing a vigorous program. Congress is expected to react favorably to the space money request because of White House support and because it represents an attractive selling point—the chance to beat Soviet Russia in landing men on the moon.

NASA's manned-space requests for Fiscal 1963 will amount to $2.26 billion, of which $1.6 billion is for research, development and operations, and the remainder for construction of spacecraft development facilities and vehicle test and launch facilities. Another $121 million is requested to supplement Fiscal 1962 funds.

To strengthen its case for a sustained effort in space, NASA is prepared to illustrate the indirect benefits accruing from space flight. Among major points to be made are that a rigorous program will create new jobs with a consequent stimulation of the economy; increase the rate of technical progress, provide new household and industrial products and materials, and provide the opportunity for scientific leadership.

Rep. Miller's View

Rep. George P. Miller (D-Calif.), chairman of the House space committee, told the American Astronautical Society last week that the space program will more than pay for itself by stimulating new technical advances on earth.

James E. Webb, NASA administrator, said he has discussed the NASA program with Rep. Miller, Sen. Robert S. Kerr (D-Okla.), chairman of the Senate space committee, and leaders of appropriations committees and has found them receptive to the NASA budget.

"I believe there will be a good, strong debate," Webb said. However, he said he thinks NASA will receive all the President requested.

Even with the indirect benefits it is the competitive race with Russia that is expected to provide the basis on which NASA will justify the growing space budget (AW Jan. 15, p. 21).

Approval of the full NASA budget will result in actual expenditures of about $2.4 billion during Fiscal 1963 since incremental funding will extend expenditures of the appropriation about three years.

Dr. Hugh L. Dryden, deputy NASA administrator, estimated the agency will spend about $300,764,000 in house for salaries and expenses and research. The remainder will go to industry, directly in contracts and indirectly through Defense Department procurement.

Following a suggestion by the Administration, NASA will present its budget request to Congress in two, rather than three general headings (AW Jan. 15, p. 25). They are research, development and operations programs, and construction programs. Salaries and expenses, previously a separate category, now are included in operations.

Agency programs are divided into six broad areas and the funding emphasis underscores the decision to use the C-5 vehicle and rendezvous technique for the Apollo circumlunar and lunar landing missions (AW Nov. 6, p. 26). NASA, however, is substantially funding the backup Nova vehicle, and will award contracts during Fiscal 1963 for booster and second stages. This vehicle could be used for direct ascent, and is the primary vehicle for flight beyond the moon.

Dr. Dryden said NASA is "putting its bets on rendezvous, but is not burning all bridges." As a result of this philosophy, the agency is asking for $26 million in supplemental funds to initiate development of the 1.2-million lb. thrust M-1 hydrogen-oxygen engine (AW Jan. 8, p. 26) and $55 million in Fiscal 1963 funds for this engine.

A cluster of four M-1 engines is seen as the propulsion package for the Nova second stage, with a single M-1 as the third stage. This configuration can carry 150,000 lb. of payload on an escape or lunar landing mission and 350,000 lb. in a 300-mi. earth orbit.

Categories in NASA's budget request and key programs in the Fiscal 1963 request and Fiscal 1962 supplemental are:

- **Manned Space Flight.** Total request

Doolittle Retires as STL Chairman

Lt. Gen. James H. Doolittle, USAF (Ret.), retired as chairman of the board of Space Technology Corp. effective Jan. 15. Gen. Doolittle requested retirement upon reaching STL's mandatory retirement age of 65 because of a desire to devote more time to the many government and industry advisory posts he holds.

Dr. Louis G. Dunn, president of STL since 1958, will succeed Gen. Doolittle as chairman of the board and Dr. Ruben F. Mettler, STL's executive vice president, has been named president of the company. Gen. Doolittle will remain as a member of the board of STL as well as member of the board of the parent company, Thompson Ramo Wooldridge Inc.

Among the posts in both government and industry held by Gen. Doolittle are these: member of the President's Foreign Intelligence Advisory Board; member of Atomic Energy Commission's Project Plowshare (peaceful uses of atomic energy); member of the Air Museum Committee of the Smithsonian Institution; chairman of the Panel on the Scientific Advisory Board; member of Massachusetts Institute of Technology Board of Regents; member of Engineering Advisory Committee of the University of California; member of the board of Shell Oil Co., and member of the board of Mutual of Omaha. Gen. Doolittle also said he has several philanthropic ventures to which he will devote his time.

NASA's Fiscal 1959-63 Budgets

	FY1959	FY1960	FY1961	FY1962	FY1962 Supplemental Request	FY1963
Research and development	$204,619,532	$333,100,000	$670,453,000	$1,295,539,000	$85,000,000	$2,968,278,000*
Salaries and expenses	86,286,300	90,850,000	170,760,000	226,686,000		
Construction of facilities	48,000,000	99,625,000	122,787,000	262,075,000	71,000,000	818,998,000
Total	$338,905,832	$523,575,000	$964,000,000	$1,784,300,000	$156,000,000	$3,787,276,000
Number of Employes	9,286	10,286	17,077	21,880		26,273

Research, Development and Operations Programs*

(In thousands)

Program	FY1961	FY1962	FY1962 Supplemental Request	FY1963
Manned Space Flight				
Mercury	$124,330	$68,278		$13,259
Advanced programs	6,266	147,242		863,628
Saturn C-1	173,908	282,193		249,237
Advanced Saturn	623	27,762	$50,000	335,172
Nova	297	6,322		163,574
Total	$305,424	$531,797	$50,000	$1,624,870
Applications				
Meteorological satellites	$19,610	$54,310		$51,185
Communications satellites	33,833	48,477		85,377
Total	$53,443	$102,787		$136,562
Space Sciences				
Sounding rockets	$12,330	$14,261		$19,157
Scientific satellites	54,398	117,618		175,165
Lunar, planetary exploration	91,019	169,964		273,560
Scout	9,452	8,206		8,947
Delta	10,479	2,927		268
Centaur	64,673	65,840	$9,000	66,664
Total	$242,551	$378,816	$9,000	$543,761
Advanced Research, Technology				
Spacecraft technology	$27,126	$37,145		$54,084
Launch vehicle technology	13,851	23,080		31,690
Launch ops technology	100	1,789		21,486
Electric propulsion	7,164	17,561		30,647
Liquid propulsion	72,726	103,901	$26,000	163,102
Solid propulsion	1,899	4,297		7,944
Space power technology	8,913	14,644		20,172
Nuclear systems technology	25,050	50,234		122,962
Aircraft-missile technology	37,857	41,479		52,588
Total	$194,686	$294,150	$26,000	$504,675
Tracking-data acquisition	$44,330	$94,844		$158,410
Total R&D & ops.	$840,434	$1,402,394	$85,000	$2,968,278

Note * Salaries and expenses included in research, development and operations in FY1963 requests

of $2.38 billion includes $877 million for development and operations of Mercury, extended Mercury, Gemini and Apollo vehicles, $748 million for development of Saturn C-1 and C-5 vehicles and Nova, $635 million for construction primarily at the Atlantic Missile Range, Mississippi Test Site, Michoud Operations Facility and Houston, Tex., site of the Manned Spacecraft Center. Total cost of the center is now $90 million, including $60 million appropriated last year.

Manned space flight also includes $121 million of the supplemental request, including $50 million to accelerate development of the C-5, $55 million to purchase land at AMR for the new launch complex and $16 million to buy land in the Pearl River, Miss., area, test site for booster and stages to be built at Michoud.

■ **Space Applications.** Total request of $139.7 million includes $85 million to begin development of advanced communications satellites in high and synchronous orbits, $51 million for development of Nimbus and Aeros weather satellites, and $3 million for construction of an applied sciences laboratory at NASA's Goddard Space Flight Center for weather and communications satellite applications.

The Weather Bureau is requesting $47.2 million for meteorological satellites (see p. 28), most of which will be transferred to NASA which acts as agent for the Weather Bureau in spacecraft and launch vehicle procurement. Weather Bureau satellites will be of the Nimbus class.

■ **Unmanned Investigations in Space.** Total, $556 million. Spacecraft development and operations will cost $468 million, and launch vehicle development, $76 million. Construction request of $12.2 million will provide a biosciences laboratory at Ames Research Center, spacecraft environmental simulator at Goddard, and support and maintenance facilities at Jet Propulsion Laboratory.

The spacecraft development and operations category reflects a maturing from research to development status of second generation all-purpose scientific satellites for geophysical and astronomical experiments. It also will provide for design studies for advanced planetary spacecraft in the Prospector and Voyager series.

NASA Construction Programs and Personnel

(Dollars in thousands)

	Fiscal 1962 Appropriated	Fiscal 1962 Proposed Supplemental	Fiscal 1962 Personnel	Fiscal 1963 Request	Fiscal 1963 Personnel
Ames Research Center	$6,115		1,675	$14,439	2,051
Atlantic Missile Range	72,225	$55,000	*	359,963	*
Facility Planning and Design	5,154			10,000	
Flight Research Center			494	1,807	550
Goddard Space Flight Center	9,180		2,394	23,780	2,794
Jet Propulsion Laboratory	3,580		†	10,360	
Langley Research Center	6,530		3,628	8,092	4,000
Lewis Research Center	1,040		3,608	43,833	4,508
Manned Spacecraft Center	60,000		1,640	30,755	2,700
Marshall Space Flight Center	25,716		6,490	33,437	7,200
Michoud Plant	980		*	34,500	*
Mississippi Test Facility	10,090	16,000	*	92,500	*
National Nuclear Rocket Development Facility	15,000		*	40,000	*
Pacific Missile Range	995		*		*
Various Locations					
Manned space flight control centers				18,000	
Propulsion development facilities	24,025			45,000	
Sounding rocket facilities	500				
Space Radiation Effects Laboratory				12,382	
Tracking facilities	20,261			35,850	
Wallops Station	7,965		399	4,300	440
NASA Headquarters			1,406		1,900
Western Ops. Office			119		125
Space Nuclear Propulsion Office			27		50
Total	269,356	71,000	21,880	818,998	26,273

* Personnel assigned from other centers

† JPL operates under contract to NASA; Fiscal 1962 employment total was 3,200.

Vehicle development program includes a $9 million supplemental request and $67 million in regular funds for Centaur, a $5 million boost in sounding rockets to attract more university participation in rocket research; funds to increase the capability of Scout from 150 to 240 lb. satellites, and final funds for the development completion of Delta.

■ **Space Technology.** Total requests, $590 million. Propulsion and space power category request is $345 million. Launch vehicle and spacecraft technology, $107 million, and $112 million for construction of a variety of research facilities at Ames, Langley and Lewis Research Centers, Goddard, JPL, Wallops Island, Va., and test facilities at Jackass Flats, Nev., for nuclear engines and stages (see p. 33).

Cyclotron Use

In cooperation with three Virginia universities, Langley will build a cyclotron to be used as a space radiation effects laboratory.

■ **Aircraft and Missile Technology.** Request, $54 million. This is primarily the non-space oriented research, largely with winged aircraft and primarily in-house. Major programs are the supersonic transport, variable sweep wings and short and vertical takeoff and landing configurations. Money request includes $1.8 million for a flight simulator and test and fabrication facilities at NASA's Flight Research Center, Edwards, Calif.

■ **Supporting operations.** Total request of $313 million includes $158 million for operating and improving tracking stations and data acquisition equipment and $155 million for new construction.

Construction programs include a new data acquisition station in the Far East and several data acquisition stations in the U.S., advanced antenna system for JPL's Goldstone facility and advanced antennas at Johannesburg, South Africa, and Woomera, Australia.

Deep Space Tracking

NASA's deep space tracking facility is made up of the Goldstone, Johannesburg and Woomera stations.

The agency does not have a separate category for bioastronautics research—a research area which caused considerable congressional questioning last year. However, NASA will spend about $27 million in this area in Fiscal 1963, both in manned space flight and space science programs.

NASA's $163 million liquid propulsion development program will be divided this way: $55 million for F-1, $55 million for M-1, $39 million J-2 and the remainder for a variety of research.

The agency has requested 58 million for development work in solid propulsion and apparently will use this money in programs involving solid rockets of 120-in. dia. or less.

Although President Kennedy last May assigned to the USAF Systems Command responsibility for developing solid propellant motors as a parallel to Saturn and Nova vehicles, Dr. Dryden said there is "no hope of getting them in the same timescale as the F-1." He said solids can be developed more rapidly, but the F-1 has been under development several years.

Dr. Dryden said there is no immediate NASA requirement for the USAF Titan 3, and no programs are geared to this vehicle. He said, however, that NASA supported the Defense Department in striking the Titan 3 a part of the National Booster Program, and Webb said NASA is deeply interested in this vehicle as a possible launcher for rendezvous spacecraft.

Titan 3 Composition

Titan 3 is a Titan 2 with two 120-in. solid propellant stages strapped to the sides (AW Jan. 8, p. 27).

The fiscal 1963 NASA budget requests 4,393 new employes to bring the total to 26,273. The agency now is in the midst of a drive to recruit several thousand scientists and supporting personnel to bring its roster to the approved FY1962 level of 21,800.

Impact of Boeing Profit Ruling Weighed

By Katherine Johnsen

Washington—U S Tax Court's order to the Boeing Co to refund $13 million in excess profits—the court's first decision in a major renegotiation case—is being weighed in the light of the effect it will have on Defense Department's incentive contract program, on extention of the Renegotiation Act, and on pending aerospace renegotiation cases totaling more than $120 million

The court struck a middle-ground between Boeing's basic policy contention that its profits should be based on sales and the Renegotiation Board, which argued that they should be based on the company's net worth

Net Worth Theory

Judge Craydon G Withey, assigned the case by the Tax Court, subscribed to the net worth theory with the important modification that a company's investment in developing technical and engineering know-how should be considered as net worth His opinion was filed Jan 10

Under the Renegotiation Board's criteria, Boeing's profits of $56 7 million for 1952 amounted to about 98% of its net book worth of $57 8 million

While this indicates "an unusually high profit," Judge Withey said, "its books do not account for the value of its design engineering and manufacturing know how categories of know-how in the highly competitive airframe industry constitute an asset which is of great value which should be added to its book net worth in applying the net worth factor"

In Boeing's case, the judge said, this know how was of at least the value of all its book assets combined." He estimated Boeing's return on "whole net worth" at approximately 50%" instead of 98%

There is general agreement in industry and government that the Boeing decision represents a major blow to any type of incentive contracting It sets a judicial precedent for the recapture of incentive payments awarded by Defense Department in the renegotiation process Of Boeing's 1952 profits, 88 8% came from work performed under incentive contracts Under renegotiation law a firm's total profits from its total government business for the year are evaluated There is no contract-by-contract determination

William M Allen, Boeing president, commented

"We strongly believe in the type of contract which rewards efficiency and penalizes inefficiency The Department of Defense demonstrated a similar belief by using the incentive type of contract which this judge finds objectionable

"Judge Withey's ruling, if not corrected, could seriously undermine the integrity of contracts negotiated by the Department of Defense and might have an important adverse effect upon military procurement"

Boeing's net financial stake in the 1952 case is about $900,000 The company estimates that if the $13 million were not refunded through renegotiation about $12 1 million would be returned to the government anyway in taxes at the 70% excess profits tax rate

The company intends to fight the case to the end It has asked for a review before the full 16-member Tax Court Such a review or an alteration in the Withey ruling are highly unlikely, in the view of legal observers here

Renegotiation Board's original 1952 determination against Boeing amounted to $9 8 million During the course of the court trial, which started in October of 1958, the Justice Department on the recommendation of the Renegotiation Board raised the claim to $20 million

In lowering the determination to $13 million, the Tax Court not only modified the formula for determining net worth but also discounted most of the Renegotiation Board's allegations of inefficiency in Boeing's management and performance The court also stressed Boeing's contribution to the national defense, particularly in the production of 299 B-47 bombers to serve as the backbone of bombardment forces

The court said Renegotiation Board's numerous criticisms of Boeing's performance in the B-47 procurement were "unreasonable," noting that it was "the largest single procurement ever by that time made by the military services of this country" He said Boeing was required by the Air Force to make 2,000 changes in design during the year, to use its urgently needed technical personnel to supervise the work of 200 subcontractors, and to share its B-47 know-how with two competitors, Lockheed Aircraft and Douglas

Cooperation Cited

Judge Withey's opinion recognized Boeing's cooperation with Lockheed and Douglas with respect to the manufacture of an airplane which was clearly a prototype for future commercial airline use'

It added that Boeing "believed at the time that a potential commercial market existed for such airframes After events have borne this out The benefits [Boeing] would normally have expected to reap because of its position as the designer and developer of the first swept-wing jet-powered airplane suitable for commercial airline use were voluntarily relinquished That it was paid for its part in making it possible for Douglas and Lockheed to manufacture B-47s does not detract from the risk it incurred nor adequately compensate it for this type of risk"

In the case of the B-50 the court opinion stated, Boeing was "clearly inefficient" in its delivery of 22 aircraft in 1952 under a contract calling for delivery of 36

Disarmament Dollars

Washington—President Kennedy last week asked Congress to more than triple the budget of the U S Arms Control and Disarmament Agency by raising it from the $1 8 million appropriated for Fiscal 1962 to $6 5 million for Fiscal 1963

Congress established the agency last year at the President's request The agency estimates it will spend $4 million on research contracts with private and public institutions It also wants to increase its staff from 126 to 220 persons

President Kennedy also requested $30 million for research and technical services at the National Bureau of Standards The bureau said that particular emphasis will be given to standards for radio and microwave quantities, measurement and standards problems in plasma physics and astrophysics and high temperature standards and measurement methods The request is $6 5 million higher than the Fiscal 1962 appropriation for research The bureau also plans to spend $730,000 for design of a radio standards laboratory and $720,000 for the construction of a plasma physics building, both slated to be located at the Boulder, Colo, site.

MRBM Competition

Washington—Air Force will have to reprogram some of its Fiscal 1962 funds to begin work on the Medium Range Ballistic Missile (MRBM), which was recently authorized by the Defense Department (see story p. 26)

Funds programed for the project amount to $6 million for Fiscal 1962, and the Fiscal 1963 request is for $122 million, about half of which will probably be used in that fiscal year

Requests for proposals now are scheduled to be circulated to industry before Feb 15 on the basis of six associate contractor categories (AW Jan 15 p 23)

Space Council Funds

Washington—Congress has been asked for $530,000 to operate the National Aeronautics and Space Council, which will remain at a personnel level of 32

The amount is $15 000 less than the Fiscal 1962 request The difference is due to new equipment and other expenses when the council was activated last year under the chairmanship of Vice President Lyndon B Johnson

The council was authorized in the 1958 Space Act, but never was used in the Eisenhower Administration Under the current Administration the council is the top White House advisory agency on policies, plans and programs for aeronautical and space activities It has been credited with establishing the manned lunar landing project as a national goal

Meanwhile, congressional supporters of renegotiation and spokesmen for the aerospace industry are at odds as to what effect the Boeing decision will have on action this session to extend the law It is due to expire June 30

John Courtney, counsel for the House Armed Services Committee said that the Tax Court decision by vindicating the fairness and justice of the Renegotiation Board determination, unquestionably will give supporters a stronger hand in fighting any move to amend the law

A spokesman for Aerospace Industries Assn said the Boeing case from beginning to end, was a fine illustration of the arbitrariness of the renegotiation process

First the regional board decided that Boeing had not made any excess profits for 1952 then the main board in Washington decided the excess profits amounted to $10 million, then in the Tax Court trial it was decided that the excess profits amounted to $20 million and then the Tax Court decided they amounted to $13 million," he said

AIA has abandoned hope for repeal of the law The association has recommended to the Joint Congressional Committee on Internal Revenue that it be amended by placing the board within the Defense Department, by shifting the burden of proof from the contractor to the government, and by granting the same right of appeal from the Tax Court to the U S Court of Appeals that is now provided in tax cases

Other aerospace manufacturers are studying the Boeing case to decide whether or not they should proceed with their own cases Boeing itself has three other cases pending before the Tax Court totaling $24 7 million They are $7 5 million for 1953 $10 million for 1954 and $6 8 million for 1955 Two North American Aviation cases, involving $6 million in excess profits for 1953 and $14 million for 1954 have already been tried before the Tax Court, but decisions have not yet been handed down Two other North American cases are awaiting trial, $9 million for 1955 and $4 million for 1958

Other cases awaiting trial are:

- **Ling-Temco-Vought, Inc**, $4 2 million This includes $750,000 for 1952 and $3 5 million for 1953
- **Fairchild Stratos Corp**, $2 million for 1953
- **Douglas Aircraft Co**, $19 5 million This includes $6 million for 1953, $6 million for 1954, and $7 5 million for 1955
- **Martin Marietta Co**, $18 3 million This includes $3 5 million for 1953 $6 5 million for 1954 $3 5 million for 1955, and $4 8 million for 1956
- **Lockheed Aircraft Corp**, $19 6 million This includes $6 million for 1953, $6 million for 1954, $3 5 million for 1955, and $4 million for 1956

Increases Requested For Nuclear Projects

Washington—President Kennedy last week asked Congress for sharp increases in appropriations for design and production of nuclear weapons and development of nuclear powerplants and power supply units for space vehicles

In his Fiscal 1963 budget request the President asked Congress to give the Atomic Energy Commission $742 million for nuclear weapons work, an increase of $112 million over the $629 8 million appropriated for Fiscal 1962 The requested increase is similar to the increase between Fiscal 1961, when $517 7 million was appropriated and the Fiscal 1962 figure

The President also asked for sizable increases in space and military reactor development They would be offset by cuts in civilian reactor programs They include

- **Project Rover** This joint AEC National Aeronautics and Space Administration program to develop a nuclear rocket stage for lunar and planetary flights received $68.9 million for Fiscal 1962, with AEC receiving $43 4 million of that and NASA $25 5 million For Fiscal 1963, the President asked more than double this total—$74 8 million for reactor development and $10 million for plant expansion in the AEC budget and $62 million in the NASA budget NASA's request is split $35 million for the Nerva engine and $26 million for the Rift stage in which the engine will be tested
- **Snap** This program is aimed at developing small nuclear power sources that will supply electrical power for space vehicles A total of $72 million was requested for AEC reactor development for Fiscal 1963, compared with $50 1 million appropriated in Fiscal 1962

AEC said the additional money would start a new program to develop a high-power system for communications satellites reconnaissance systems and space probes, called Snap-50

Although the request for the Project Pluto ramjet reactor program rose only from $24 million last year to $26 5 million in the new AEC budget the Air Force asked for $23 million for vehicle development—its part of the joint program The reactor would propel a supersonic low-altitude missile such as those proposed under USAF's SLAM studies

Echo 2 Films Studied For Cause of Failure

Washington—Echo 2 sphere broke apart during an inflation test Jan 15 from the Atlantic Missile Range National Aeronautics and Space Administration hopes to pinpoint the cause from television and motion pictures taken during the flight

The 500 lb sphere boosted on a vertical trajectory by a standard USAF Douglas Thor missile, apparently had successful launch and payload ejection phases but the inflation sequence was described as "violent" in video pictures monitored at AMR (AW Jan 8, p 28)

Second booster and payload are available for another test probably in March

The 16 mm motion picture data capsule was recovered about 250 mi northeast of the island of San Salvador

Inflation process was designed to take about 15 min but the sphere was completely inflated in about 30 sec and then broke apart

Optical Surveillance

Industry proposals are due this week for a new optical space surveillance subsystem intended to detect space vehicles at ranges of 3 000 to 300 000 mi Program known as Prototype Optical Surveillance Subsystems (POSS) calls for installation of one or two telescopes atop a mountain in Arizona Image orthicons and data processing techniques will be used to detect objects whose images are not visible to the naked eye Installation is to be completed by the end of the year Approximately a dozen companies are expected to submit bids to USAF's Electronic Systems Division

Rome Air Development Center in what appears to be a related program plans to award a contract for development of passive optical techniques for distinguishing earth-orbiting objects from stellar backgrounds using reflected solar energy for target illumination

Big Army Shift Affects Technical Offices

Washington—Sweeping Army reorganization which will abolish three of the nine technical services, take away the statutory character of five others, establish a Materiel Development and Logistic Command (MDLC) and an Army Combat Developments Command (ACDC) and alter segments of the headquarters staff was announced last week by Army Secretary Elvis J Stahr, Jr.

Only the Corps of Engineers, which performs many civil functions in the U S, will remain as a separate statutory technical service The Office of the Surgeon General will lose its statutory status but will be retained as a separate entity

Each of the technical service chief officers was given his title and authority under law This statutory status would be lost by seven of them under the new plan

The offices which will be abolished are Quartermaster General, Chief of Ordnance and Chief Chemical Officer

Those whose functions will be changed, their titles retained but their statutory status abolished are Chief Signal Officer, Adjutant General, Chief of Finance and Chief of Transportation

Similar to Air Force

MDLC, under the command of a four-star general, whose headquarters will be in the Washington area, will shepherd weapon systems from the applied research stage through development to operational status, and then provide logistic support to user commands In effect, it will perform functions in the Army which in the Air Force were placed under the Air Force Systems Command and the Air Force Logistics Command in April of last year

The Army Combat Developments Command will take over combat development functions now assigned to the Continental Army Command (CONARC) The shift will also take many functional activities from the Army General Staff and will leave it mainly a planning and policy making group An estimated 18 months will be required for the entire reorganization

The reorganization will not produce any significant changes in the arsenals, laboratories, depots, test ranges and installations

Direction of some of these services and activities will shift to MDLC, and some to ACDC MDLC will change emphasis in the development of Army weapons to concentrate on the project management concept, resembling the Air Force's designated systems approach and also the Navy's Polaris project

In order to abolish the billets of Chief Signal Officer, the Adjutant General, the Quartermaster General, the Chief of Ordnance, the Chief Chemical Officer, Chief of Finance and the Chief of Transportation the Secretary of Defense will take advantage of a provision in the National Security Act of 1947, as amended The statute provides that the action becomes effective 30 days after the Armed Services Committees of the Senate and House of Representatives have been notified unless they veto the proposal They were notified Jan 16

Functions Reassigned

The functions of the offices of the Chief of Ordnance and the Chief Chemical Officer will be reassigned The staff and service functions of part of the Office of the Quartermaster General will be performed by the Chief of Support Services, who will be assigned to the Deputy Chief of Staff (Logistics)

The staff and service functions of the Chief Signal Officer, Chief of Transportation, Chief of Finance and Adjutant General will be performed by headquarters staff officers with the same titles

Stahr said these are the objectives of the reorganization

- **Eliminate duplication** of effort and excessive fragmenting of functions, responsibilities and resources
- **Consolidate responsibilities** for personnel management, training, combat developments, research and development and logistics functions in the smallest practicable number of commands and agencies
- **Provide an organization** which is better adapted to changes in the general defense environment which have evolved since 1953, when the last comprehensive study of the Army organization was made
- **Improve effectiveness** by more clearly fixing responsibility for accomplishment of major tasks and by simplifying and strengthening the command and management structure
- **Provide for more flexible** use of skills and capabilities of military personnel and for correspondingly broader technical opportunities
- **Delegate to subordinate commands** and agencies all functions which need not be performed at the level of the Secretary of the Army and the Army General Staff

Commenting on the reorganization plan, Secretary of Defense Robert S McNamara said "While the land forces had a significant role in the past, I believe that because of technological and other developments they will play a much larger role in the strategy of the future

Functions of New Command

MDLC will perform the wholesale materiel functions of research and development, procurement and production, inventory management, storage and distribution and maintenance and disposal, all of which are now assigned to the technical services It will test new weapons and equipment, which has traditionally been done by CONARC and the technical services

MDLC will also control the development, testing, production and supply of materiel, including the operation of laboratories, arsenals, proving grounds, test ranges, depots and transportation terminals

ACDC activities will include the development of organizational and operational doctrine, materiel objectives and qualitative requirements, war gaming and field experimentation and cost effectiveness studies

ACDC will include many personnel now in the combat development system and personnel from the Army school system who are responsible for doctrine, field manuals and preparation of tables of organization and equipment

CONARC will be responsible for the training of all individuals and units of the technical and administrative services and the combat training of the Army in the field This will include the Army National Guard and the Army Reserve

Sage Backup Briefing

Air Force plans for a Sage system backup in its continental air control and warning system (416-L) program, of which the Sage system is the heart, will be outlined to prospective bidders at a Rome Air Development Center briefing early in March

The backup system, called BUIC (for Backup Interceptor Control), will monitor Sage but be autonomous of it and will provide control of manned interceptors, Bomarc and Nike surface-to-air missiles against hostile manned bombers which might lead a second wave attack after Sage installations were destroyed in a first wave ballistic missile assault

Specifications were prepared by Electronic Systems Division, Mitre Corp and RADC. Bidders probably will include Burroughs, General Electric, Hughes, International Business Machines Corp, Litton Industries and Martin Marietta Backup system previously was referred to as SABU (Sage Backup)



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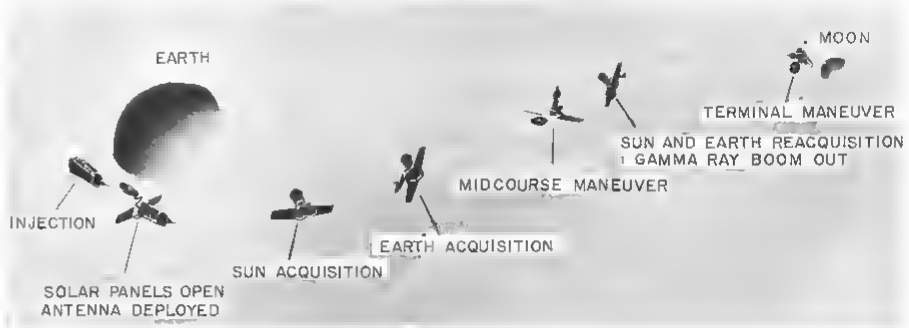
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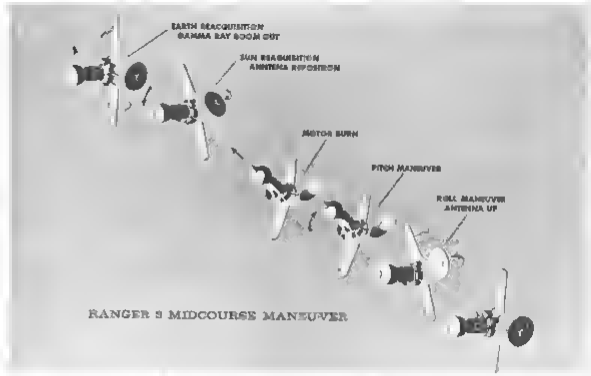
RANGER 3 flight plan calls for seven steps detailed in diagram above. Midcourse maneuver provides precise alignment for moon impact

Lunar Surface Data Is Goal of Ranger 3

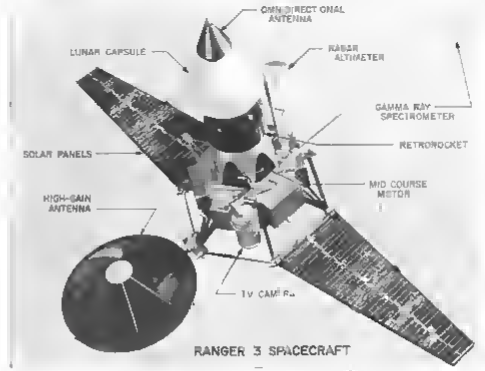
Washington—Ranger 3 payload is scheduled to be launched Jan. 22 from the Atlantic Missile Range primarily to photograph the lunar surface, make a hard landing and then relay information on surface characteristics as a preliminary to manned lunar landings.

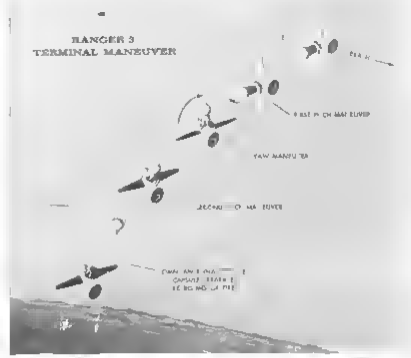
National Aeronautics and Space Administration considers the 10-point Ranger 3 mission so complex that it has scheduled three identical flights this year. If any of the three complete the mission, the Ranger lunar impact program will be considered successful. Rangers 1 and 2, which were spacecraft and component tests, were only partially successful when they were injected into low earth orbits rather than highly elliptical orbits as had been planned. (AW Nov. 27, p. 27)

The 727-lb. Ranger 3 payload to be launched by an Atlas Agena B vehicle



GAMMA RAY BOOM is extended after Ranger 3's midcourse maneuver is completed.





COMPONENTS of Ranger 3 are grouped around midcourse motor. Lunar capsule is made of balsa wood and designed to withstand impact speed of approximately 150 mph. Transmitter is expected to operate for a month. Terminal maneuver is detailed at right.

Apollo Launch-Escape System Studied

North American Aviation's Space and Information Systems Division is evaluating proposals from industry for the Apollo spacecraft launch-escape solid propellant motor system. North American requirements specified these highlights:

- Reliability of 0.9880 is expected.
- Motor weight should not exceed 5,000 lb. for the three-nozzle canted configuration.
- Normal thrust will be 200,000 lb. at sea level and a temperature of 70F. Burning duration will be for 2 sec., at maximum steady state thrust. A highly aluminized propellant (normally contributing to higher specific impulse) is not desired, probably because of undesirable chemical reaction under storage conditions.
- Minimum ignition time of 70 milliseconds to 90% of normal thrust is desired. The igniter is expected to operate satisfactorily with 18 to 30 v.d.c. and withstand one watt per current for 48 hr. without firing or detonation, and be capable of firing with current limited to 3 amp.
- Successful start and operation is expected at ambient pressures of zero to 15 psia., exhausting to ambient temperature of −100F to +150F and in any attitude under flight maneuver loads.
- Thrust vector control by fluid injection is desired but alternate systems for thrust vector control will be considered.
- Escape tower and rocket system will be jettisoned if launch is successful.

will follow this mission sequence: attain a parking orbit, re-start and reach a 24,500 mph. escape velocity, perform a three-axis maneuver to lock on to earth and the sun, go into a collision course, with the moon on the basis of course change commands from earth by use of a mid-course guidance motor, re-establish its earth-sun reference, perform a 180 deg. yaw maneuver at an altitude of 5,000 mi. from the moon, operate a video camera as it approaches the moon, study the lunar composition and radar reflection characteristics, separate a braking rocket and capsule at an altitude of 70,000 ft., fire the rocket to slow the package to zero velocity at an altitude of 1,100 ft., and finally rough-land the capsule, which is designed to remain active 30 days to transmit data on quakes and meteoric impact.

Spacecraft Dimensions

The Ranger spacecraft is 5 ft. in dia. and 8.25 ft. high in its launch configuration.

Two solar panels will be unfolded in flight to increase the base dimension to 17 ft.

The lunar television camera electronics and tube were designed for the experiment by Radio Corp. of America. Jet Propulsion Laboratory, overall manager for NASA's lunar and planetary programs, developed an optical telescope which provides the equivalent of a 40-in. focal length lens. Electron gun structure was developed by General Electrodynamics Corp.

The camera resolution will produce 200-line pictures transmitted to JPL's Goldstone antenna. One picture will be transmitted every 10 sec., with a three-second erasure interval, for most of the final 40 min. of flight. Separation of the survival capsule 8.2 sec. before impact is expected to disturb the orientation so that transmissions will end at this point.

Other scientific experiments in the payload are:

- **Gamma ray spectrometer,** to detect the uranium, thorium, radium and potassium radioisotope emissions from the lunar surface.
- **Lunar seismometer,** designed to sense waves from quakes or meteor impacts. The device will position itself so that its antenna is pointed toward the earth.
- **Radar reflectivity,** a pulse-type radar which will operate as the payload descends to the moon between altitudes of 122 and 34 mi.

Capsule Weight

The lunar capsule weighs 328.1 lb. including a 213 lb. retro-motor system and 56.70 lb. survival sphere.

General Dynamics / Astronautics-Lockheed Atlas Agena B launch vehicle will be programed to burn 2.5 min. during the booster phase and the sustainer will burn 4.5 min. and verniers, 5 min. At booster cutoff, the vehicle will be at an altitude of 80 mi. At vernier cutoff, the vehicle-spacecraft will coast 30 sec., and then in sequence the payload fairing will be separated by spring action, explosive charges will release the Agena stage, and retrorockets will slow the spent Atlas booster.

The Agena-Ranger combination is inserted through a pneumatic control system, and the Agena ignites for 2.5 min., coasts in a parking orbit for about 14 min., and re-ignites to launch from orbit on a lunar trajectory. About 2.5 min. after the 90-sec. re-ignition, Ranger 3 will separate from the Agena B stage.

From launch to lunar impact will take about 66 hr.

Laboratories Warned On Over-Expansion

Massachusetts Institute of Technology President J. A. Stratton has cautioned the institute's Lincoln and Instrumentation Laboratories to "exercise strict self discipline against any tendency to expand our part in [government] programs beyond the area where our services are clearly necessary."

The warning, delivered Dec. 15 but made public only last week, appears to have been spurred by industry criticism of the sole-source award to MIT's Instrumentation Laboratory, by the National Aeronautics and Space Administration, for the development of Apollo guidance and navigation equipment (AW Jan. 8, p. 23). Stratton also referred to work in ballistic missile testing undertaken by Lincoln Laboratory.

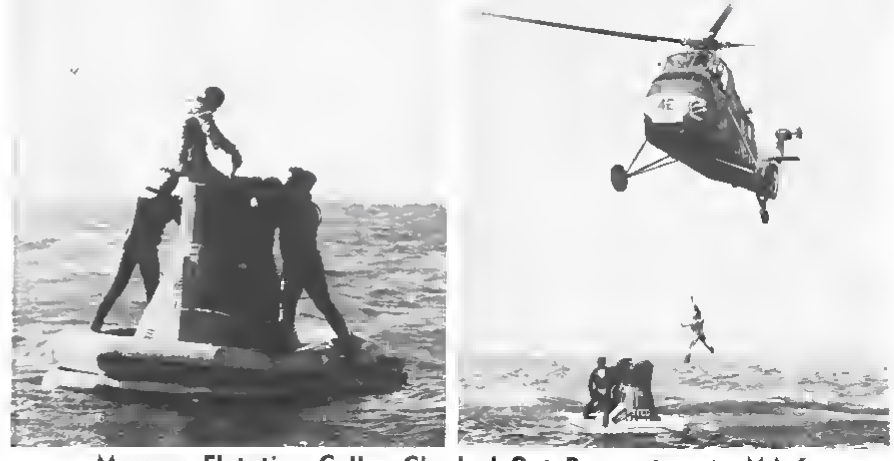
In a memorandum to administrative officers of MIT's defense laboratories, Stratton said: "We must be continually aware that much of this important work ... would be welcomed by a large number of industrial concerns ... we must push toward industry all work which can be done as well there as by MIT."

He said some expansion will of course be necessary in both Lincoln and Instrumentation Laboratories, such expansion is not to exceed that which is clearly required for proper performance of our responsibilities. Continuing attention must be devoted to the phasing out of less important work as a means for finding the people and the working space for necessary expansion." (The Instrumentation Laboratory is advertising for engineers and scientists for the Apollo program).

Stratton also warned against accepting new work beyond commitments already undertaken "to assure that in each instance the addition is necessary to the national interest and will contribute significantly to the continuing strength, not the size, of the laboratories."

Stratton also cautioned the laboratories on their role in assisting the government in selecting companies to produce hardware they develop. "The choice of major industrial associate contractors is a responsibility of government ... we must of necessity on occasion make recommendations with regard to such choices but we must be extremely careful not to influence these decisions in any undue way."

Stratton also said that new information developed by MIT laboratories in such projects "must be quickly and fully shared with all industry. This has ... always been our practice, but it behooves us especially now to review our efforts and intensify them wherever improvements may be possible."



Mercury Flotation Collar Checked Out Preparatory to MA-6

Flotation collar, designed to keep the Mercury capsule afloat for hours if necessary prior to pickup, is tested in preparation for MA-6. Scuba divers assist Astronaut Alan Shepard from spacecraft during a top egress demonstration (left). Shepard takes part in Marine helicopter pickup in demonstration at right. Marine Lt. Col. John H. Glenn is scheduled to make the MA-6 launch on Jan. 24. Three problems caused a total of eight days in delays. First was traced to a faulty gyro in the Atlas guidance package; second was a faulty servo cam in the Atlas; third a leak in the freon line which supplies cabin environmental system.

DOD Approves Technical Phase Of 120-in. Solid Rocket Program

Department of Defense has approved the technical approach for the development of the 120-in. dia. solid propellant rocket motor for the Titan 3 program (AW Jan. 8, p. 27), but various management aspects, as well as cost schedules and application of Program Evaluation Review Techniques (PERT), will have to be resolved at Air Force Systems Command's Space Systems Division.

As a result of current consideration of these factors at Space Systems Division, a request for proposals to industry is not expected to be issued before the end of January.

Contracts awarded in the resulting competition may not be entirely the cost plus fixed-fee type, because some aspects of the program may be put in the fixed price category and other aspects may be governed by incentive clauses.

Meanwhile, Space Systems Division has received the go-ahead from Department of Defense to proceed with the 156-in.-dia. solid propellant rocket motor concurrently with development of the 120-in.-dia. program, but the amount of support for the effort from Fiscal 1962 funds is questionable. Support from Fiscal 1963 funding virtually is certain, but the amount is not set.

Aerospace Corp., technical adviser to Space Systems Division, has been briefed by potential solid-propellant industry competitors with respect to their present capabilities to fabricate and test rocket motors in the 156-in. dia. category to ensure that no conflict will exist with efficient execution of the 120-in. solids program.

Anticipation is that Aerospace Corp. will recommend to Space Systems Division that the 156-in.-dia. solids program proceed immediately for development of hardware, under a design freeze. Under this approach, development is likely to begin initially with a single-segment, single-nozzle configuration and, if this development is successful, then phase into development of three-to-five-segment motors for perhaps three firings. Thrust for a five-segment 156-in. dia. motor probably would be about 1.8 million lb. Duration probably would exceed 80 sec.

Although the 156-in.-dia. solid propellant motor may become the "workhorse" unit for the Air Force, no specific vehicle application is indicated.

Work on the 240-in.-dia. motor, also being considered in Aerospace Corp.'s overall analysis of the large solids program, isn't likely to be recommended initially as more than a feasibility study, with perhaps one demonstration firing at Edwards AFB. Industry views the 240-in.-dia. development as introducing huge technical problems in almost all aspects of design and fabrication. Any development under this category definitely will require on-site fabrication in some respects.

Possible follow-on to the initial phase of the 240-in.-dia. solid propellant effort would involve design refinements aimed at lighter weight hardware and feasible thrust vector control.

Aerojet-General and Thiokol Chemical Corp. both have displayed keen interest in the 240-in.-dia. motor development despite technical difficulties involved.

Contract Awards

Washington—Major contract awards for continued production of aircraft, missiles and components last week included:

- Navy—$86,050,000 to Grumman for A2F-1 Intruder all weather attack aircraft, $26.5 million to Bendix for Talos surface-to-air missiles and $1,505,754 for development of the Typhon surface-to-air missile and $38.2 million to Raytheon for Sparrow 3 air-to-air missiles.
- Air Force—$32.86 million to North American for guidance-control systems for Minuteman intercontinental missiles and $1,177,083 for modification of the Hound Dog air-to-surface missile, $33.46 million to Thiokol for research and development on the Minuteman first stage engine, $38 million to Boeing for Minuteman production and related equipment, and $17.5 million for Dyna-Soar boost glider development.

NATO Begins Evaluation of VTOL Strike Fighter, Transport Proposals

By Ceel Brownlow

Paris—Technical working groups of the North Atlantic Treaty Organization are examining proposals of firms from the U S and other NATO nations in initial steps toward providing NATO with a V/STOL strike reconnaissance fighter and a companion medium range support transport by the late 1960s

Opinions as to the outcome range from a minority consensus of nothing to cautious optimism that the nations involved will finally agree upon a common design or designs

All, agree, however that the task of selection probably will be pocked by nationalistic demands based upon need or pride and probably both

France has let it be known that it has a nationally funded program in the fighter field which it would be glad to share but plans to continue in any event West Germany and others have maintained that the present specifications—a capability of maintaining a Mach 92 on the-deck speed for a distance of at least 250 nm—do not fit their ultimate needs

There also is a general consensus that the future of both projects will be bleak without substantial U S financial support

Latest step was taken on Jan 10 when 11 bids were submitted on the deadline date for the strike fighter competition, with several firms presenting more than one proposal as a hedge against specification changes

Prominent absentee was Germany's VJ 101 begun about three years ago on a national level and now undergoing a major structural and engine modification program, including elimination of the planned swiveling wing-tip pods for vertical lift

Revised plans for the aircraft, reportedly necessitated because of vibration and control problems, envisage use of three Rolls-Royce RB-162 lift engines and two RB-153s, all buried within the fuselage The RB-153s could provide deflected thrust as an aid to the RB 162s during vertical ascent and descent through a rotating grill located on either side of the tail pipe A clam shell arrangement in each would deflect the thrust into the grill as it swivelled downward for takeoff and landing The grill would revert to its normal position after takeoff to permit the RB 153s to provide thrust for horizontal flight

It is believed that the aircraft also is being redirected toward its pre NATO competition design as a high speed, high altitude interceptor

Germany is represented in the present round, however through two proposals submitted by Focke Wulf, one for a straight replacement for the subsonic Fiat G 91 close-support fighter in the event a decision is made in this direction, another for a more sophisticated aircraft that would be supersonic at altitude and closely follow the present NATO specifications for on the deck performance. Both reportedly are built around versions of the Bristol-Siddeley BS 53 deflected-thrust powerplant

Previously revealed competitors are Republic Thunderchief Dassault Snd and Lockheed Short Bros (AW Dec 25, p 20)

Hawker Siddeley has two proposals, one a largely standard version of the transonic BS 53 powered P 1127 which already has entered the flight test stage A refined version designated the P 1150 has a reported speed at altitude of Mach 2 2 Changes over the 1127 include incorporation of the BS 100 and a more streamlined fuselage

In the French national competition the Lorin Breguet entry, like the rejected VJ 101, envisioned use of three RB 162s for vertical thrust and two RB 153s for horizontal flight Designation at the time was the Breguet 1110

Fiat has teamed with West German southern group of Bolkow, Heinkel and Messerschmitt, which decided against entering its VJ-101 project New group will design a V STOL strike reconnaissance aircraft for NATO The agreement still is subject to approval by the West German and Italian governments

National delegations will have approximately two months to study the proposals and submit their initial findings and recommendations to the NATO Secretariat

On the transport side NATO and national groups are working to pare down the unexpectedly large total of 27 bids submitted before the Nov 24 deadline for BMR-4

Allocation of funds especially U S., is regarded by advocate and opponent alike as the keystone of the NATO projects U S willingness to underwrite development and prototype costs, they believe, could go a long way toward breaking down national barriers and acceptance of a common design

An advocate of the fighter program who has been working for its adoption concedes that the U S will have to step in He also believes the program may evolve into a requirement for two or three specific types of aircraft designed for different missions, partially for practical reasons partially to satisfy national pride

News Digest

USAF's High Altitude Propulsion Test Cell at Arnold Engineering Development Center, Tullahoma, Tenn, recently underwent a qualification test in which Agena B stage was kept in a 3×10^{-4} mm of Hg vacuum for seven days The J-24 cell will eventually test engines under space conditions during firing

North Atlantic carriers of the International Air Transport Assn are holding another mail vote on the subject of low-cost group fares between North America and Europe A recent mail vote covering group fares and extended individual excursion fares was negative In the balloting begun last week the excursion fare has been eliminated and only the group fare is up for vote This is a proposal for special fares for groups of 25, with a New York-London round trip fare of $300

Richard S. Bontelle, former president of Fairchild Engine and Aircraft Corp, died Jan 15 in Hagerstown Md at the age of 63

Ryan Aeronautical Co. earned a record $3,304,645 or $1 89 a share after taxes in the year ended Oct 31 a 14% gain over Fiscal 1960 net income of $2,894,055 or $1 68 a share Sales for Fiscal 1961 were $89,448,172 compared with $122,711,095 for the previous year

Air Line Pilots Assn remained deadlocked with Pan American World Airways and Trans World Airlines last week in labor disputes over turbojet crew complement and wages Federal mediators were unable to make progress in either dispute and a pilot strike was considered possible

Number three X-15 made its second flight Jan 17 attaining a maximum speed of Mach 5 25 (3,715 mph) and a top altitude of 133,000 ft National Aeronautics and Space Administration test pilot was Neil A Armstrong

National Airlines has filed for a New York Miami shuttle service to match a similar jet service Eastern recently filed for with Civil Aeronautics Board (AW Jan 15, p 38) National, however, opposes the low-fare service and is filing defensively only

Republic of Ireland is making plans for its first aircraft manufacturing plant Established by Potez of France, the factory will produce P 840 turboprop transports Aircraft will be completely manufactured in Ireland with the exception of engine and specialized equipment (AW Oct 2, p 85)

Late Traffic Spurt Raises Airline Hopes

December figures bring cautious optimism, but no change seen in trend toward mergers as solution.

By L. L. Doty

New York—Sudden spurt in domestic trunkline traffic activity during the last quarter of 1961 after 15 months of business doldrums, is leading many observers to feel that the industry s historic growth pattern may be restored this year

The trend reversal, if it materializes on a long range basis, could ease many pressures on the industry and the Civil Aeronautics Board for quick solutions to the airlines current financial dilemma Observers here feel, however that it would not alter the strong pro merger attitude of CAB and the industry, or lessen the stress being placed on the continuing problems of over capacity and excessive competition

The drive for mergers particularly among larger carriers, is gaining momentum, accelerated by a rare accord between the industry and at least a majority of CAB members Capacity and competition are continuing to depress load factors to an unhealthy level

Optimism over 1962 prospects is general although tempered by the possibility that the fourth quarter showing may have been only temporary Revenue passenger miles rose 8% in the final quarter of 1961 over the same period in 1960—the largest quarterly increase since 1960's first quarter when trunkline traffic climbed 8 6%

Traffic No Cure-all

The majority of top airline officials here feel that even a substantial traffic hike in 1962 while welcome, will not be a panacea for the industry's fiscal ills They point to the 11 3% traffic increase in November — the biggest monthly increase since Jan 1960—and note that in November, the industry suffered a net loss of $7 9 million

The feeling is also strong that even if a normal rate of traffic growth emerged during the next few years, the industry as it is now constituted, would be unable to survive until traffic volume rose to a level adequate to absorb capacity During the interim period, it is felt, some carriers would face bankruptcy unless rescued by merger Thus, many observers now feel that trunkline industry is irretrievably committed to a series of mergers as its only salvation

However there are warnings by some that a realignment industry could meet with disaster if it fails to measure in advance the possible impact of wholesale mergers

These warnings are sounded by groups who charge that no studies have been made of the long range effects of mergers on competition that most exploratory merger talks between companies are conducted without any guidelines leading to an industry goal that some mergers could create a competitive imbalance by making strong carriers stronger, weak carriers weaker

990 Cancellation

New York—Cancellation of the Hughes Tool Co. order for 13 Convair 990 jet transports means the Hughes aircraft will not be built according to General Dynamics.

None of the planes is in an advanced state of construction Hughes and General Dynamics agreed that Hughes will pay a flat cancellation charge for scrapping the order

The Hughes 990s would have been the last of 50 to be built. Seven of the remaining 33 still are unsold—five representing a cutback of American's order and two canceled by Scandinavian Airlines System It is understood, however, that General Dynamics is negotiating for the sale of these seven aircraft

The tool company will under the new agreement, accept delivery of four additional Convair 880s as originally ordered Hughes Tool has made prior payments for the 990s exceeding the amounts due under the 880 contract by about $7 million of which the manufacturer will return $1 5 million in cash and a promissory note for $2 million Balance covers the 990 cancellation charge accrued interest and a credit for purchase of spares and related equipment.

Hughes Tool last week had no comment regarding disposition of the four 880s, but speculation lists Northeast as a possibility

Capacity-Traffic Ratio

In the first quarter of 1961, when traffic was down 4%, available seat miles dropped 7 2% In the final quarter of the year the 8% revenue passenger miles increase was matched by a 13% increase in available seat miles

During 1960, capacity was held to a 2% increase in the last quarter when traffic declined 1 2%. Int capacity was allowed to expand by 13% in the first quarter when traffic moved up by 8 6%

The seriousness of the capacity problem, however, is highlighted by the trunklines load factor record The 56 2% load factor registered in 1961 is the lowest reached by the industry since 1938

Despite traffic improvements in the last quarter of 1961, the load factor fell to 54%, a drop of 3% from the first quarter when traffic dipped 4%

Current optimism over 1962 prospects rests in large part, on the success the trunklines enjoyed during December In that month generally a poor traffic month, industry revenue passenger miles climbed 10 83% with all 11 trunklines sharing in the gain National Airlines led the group with a 41 8% increase in traffic, Northeast

It is difficult to find anyone within the industry today who will not identify excessive competition as the real source of the airlines problems Not many, however, will agree that the industry has re-equipped itself into a condition of over capacity

Increased fares are considered by at least one major airline as a possible means of bolstering revenues depressed by excessive competition Others admit that fare increases may help, but cling to mergers as the best method

In view of the CAB's general resistance to tariff increases and its recent encouragement of mergers fare increases are not likely to be pushed generally at this time Although the airlines will accept any increases CAB authorizes they do not agree on whether higher fares will or will not discourage traffic growth A number of officials believe that new markets can be opened only through lower promotional fares

The industry has been fairly successful in coping with the over capacity issue Although the rise in available seat miles has continued trunklines have been able to adjust capacity to demand on a seasonal basis as well as can be expected in an operation calling for a relatively high aircraft utilization rate

Airlines was a close second with a 41.5% increase, followed by United Air Lines with a 25.4% gain.

Industry load factor remained about the same despite the fact that seven of the 11 carriers were able to improve their monthly load factor standing, with Continental Airlines and the East Coast-Florida carriers showing substantial improvement.

However, only four carriers were able to improve first-class load factors during the month. Seven carriers raised coach load factors slightly. Only American Airlines had an overall load factor over the 60% mark but all carriers were either above or reasonably close to the 50% level.

All carriers showed an increase in coach revenue passenger miles, but only two—Northeast and United—were able to move ahead of the previous December in first-class revenue passenger miles. In comparing United's traffic figures with prior periods, Capital Airlines' 1960 traffic is consolidated with United's.

First-class revenue passenger miles for the industry dropped 10% in December and available seat miles fell 7%. Coach revenue passenger miles, however, rose 29% and coach available seat miles climbed 28%. The 10.8% increase for all categories of traffic was matched by a 10.4% increase in all classes of available seat miles.

Major Shifts Asked in Airway Users Tax

Washington—Federal Aviation Agency assessment of how much benefit each branch of aviation gains from the airway system is reflected in President Kennedy's budget, which urges a major overhaul of taxes now paid by users of U.S. airspace.

Although the new levies would return somewhat less money in Fiscal 1963 than present taxes, the burden of payments would rest upon a broader foundation than is now the case. In essence, scheduled air carriers would produce less revenue while general aviation would produce more. But a recommendation that would end what FAA Administrator N. E. Halaby has described as the air freight industry's "free ride on the airways" promises to be the most controversial item in the proposal.

Here is the President's proposed federal tax package:

- **Current 10%** tax on all airline passenger tickets would be decreased to 5% on Dec. 31, 1962 and a new 5% tax would be levied on all waybilled air freight. The 10% tax on railroad and bus transportation would be removed completely at the same time.
- **Aviation gasoline** tax of two cents per gallon would be extended, as recommended last year, to cover jet fuels. In addition the tax rate on general aviation fuels would rise from two to three cents per gallon.
- **Revenues generated** by these taxes—an estimated $164 million in Fiscal 1963—would be retained in the Treasury's general fund instead of the highway trust fund.

Even if the new measures become law, the federal government can expect to recover only about half of the $325 million it is spending on the overall Air Traffic Control System. To gain additional revenue, Halaby had considered a general registration tax on all U.S. aircraft and an excise tax on aircraft being built. These schemes were rejected, he said last week, because they ran counter to the philosophy of a user tax. Continuation of current taxes would bring in about $154 million in Fiscal 1963.

The broad outline of FAA's proposed $790.5 million budget, as released by the White House last week, does not indicate FAA interest in embarking on vast new spending projects next year in either research or air traffic control. Rather, the budget asks relatively modest 9 to 13% increases in both line personnel and new obligational authority for the Agency's major operating divisions.

The Budget Bureau granted FAA nearly everything it requested for specific projects according to Halaby. The budget therefore, is ample to fund the first steps toward carrying out recommendations of the Project Beacon report, which calls for a new civil ATC system to be developed over the next five years at an overall cost of $500 million.

Halaby did hint that the Federal Aid to Airports Program, which is scheduled for release late this week in the form of a National Airport Plan, may disclose strong FAA participation in several controversial projects. Possibilities include an FAA promise of aid to groups interested in converting the abandoned Mitchel AFB on Long Island, N.Y., into a general aviation airport, or an FAA grant toward building a new jetport in New Jersey.

In making Fiscal 1962 appropriations, Congress authorized FAA to spend $11 million to begin the civil supersonic transport program, on the condition that a substantial portion of this money be recovered from industry at a later date. In 1963, as was predicted last year by FAA, the agency seeks $25 million to complete its two-year study of whether such a transport is economically and technically feasible. By late Calendar 1963, FAA feels that enough data will be on hand to determine whether continued government-supported research would be in the national interest.

FAA's Fiscal 1963 budget request is an increase of 8.3%—or $61 million—over the $729.8 million authorized by Congress for Fiscal 1962. The Agency's personnel strength would climb from the 43,778 permanent positions now authorized to 47,775, an increase of about 9%. Most of the new employes would be field service technicians or air safety inspectors and staff personnel.

FAA Fiscal 1963 Budget Request

(In thousands)

Appropriation New Obligational Authority	1962 Appropriation	1963 Estimate	Difference
Operations	$434,300	$492,500	+$58,200
Facilities and equipment	120,000	135,000	+15,000
Research and development	60,000	50,000	−10,000
Operation and maintenance Washington National Airport	3,225	3,725	+500
Operation and maintenance, Dulles International Airport	1,975	3,675	+1,700
Construction, Washington National Airport	4,200	2,500	−1,700
Construction and development additional Washington Airport	20,100	3,400	−16,700
Grants-in-aid for airports*	75,000	75,000	
Civil supersonic aircraft development	11,000	25,000	+14,000
Total new obligational authority	$729,800	$790,000	+$61,000
Liquidation of Contract Authority			
Grants-in-aid for airports*	70,000	20,000	−50,000
Total appropriation	$799,800	$810,000	+$11,000

* $150 million appropriated during Fiscal 1962—limitation of $75 million for 1962 and $75 million for 1963. An additional $75 million being requested for 1964.

Yugoslav Caravelles

Jugoslavenski Aerotransport Yugoslav national airline will use Caravelle transports to introduce jet service on its West Europe and Middle Eastern routes.

JAT officials reportedly shortly will announce purchase of three Srd Aviation Caravelle Mark 6N transports. N version is same as Mark 6R except for removal of jet reversers.

Delivery dates on the JAT Caravelles were unknown. Yugoslav carrier however had planned to introduce jet service by 1963 (AW May 8, p. 43).

Caravelles, first jet equipment for JAT, probably will be used on carrier's medium range routes such as Cairo and Paris.

expenses incurred under earlier authorization to grant funds to airports. A supplemental appropriation for last year's budget authorizes FAA to spend $75 million on airport aid in Fiscal 1962 and 1963. In addition to these two items, FAA is seeking an appropriation of $75 million for Fiscal 1964, thus giving airport operators time to plan their terminal improvements well in advance.

In the research and development section of its budget, FAA asks $50 million in new obligational authority, including $2,092,000 for aviation medical research. In 1962, $60 million was appropriated for research and development. But comparison of appropriation figures, according to FAA, does not give a true indication of the increased emphasis accorded research and development. Instead, the trend in obligations is a better index. This shows that in 1961 those obligations totaled $51 million, in 1962 they totaled $68.6 million and in 1963 an estimated $74.6 million will be obligated, 9% more than in 1962.

CAB Budget Reflects Its Desire To Avoid Big Subsidy Increase

Washington—Civil Aeronautics Board planning to hold subsidy payments to nearly the level of the current fiscal year has requested a Fiscal 1963 budget only $1.8 million higher than that of 1962.

New obligational authority requested totals $95.9 million, reflecting an increase of $1 million in administrative expenses and a $734,000 gain in subsidy payments.

However, the Board has estimated that extensive reductions in the subsidies paid helicopter and Alaskan carriers, combined with the new class mail rate subsidy plan for 13 local service airlines may produce an actual 1963 subsidy bill only $54,000 greater than the $84,188,000 predicted for the current fiscal year.

A breakdown of the estimated subsidy payments shows $71.4 million earmarked for local service carriers, $5.8 million for helicopter airlines, $7.8 million for Alaskan and $1 million for Hawaiian operations. Compared with expected subsidy payments for this fiscal year, the budget increases local service payments by $5.4 million, most of which will cover the costs of new route mileage and equipment assumed by the airlines.

In contrast, $1.1 million was cut from the expected subsidy needs of the nine Alaskan carriers and $150,000 from the subsidy estimates for the three helicopter operations.

CAB has estimated that its increased workload will require an administrative budget of $9.9 million in Fiscal 1963—a $1-million increase over the current fiscal year. Most of the increase will be used to hire 75 additional employes in the GS-11 through GS-13 pay grades.

More than half of these will be assigned to the Bureau of Safety. The balance will be added to the Board's economic staff in an effort to expedite formal hearing procedures in route and rate cases. Addition of the new personnel would bring the CAB's permanent work force to 948 people, with an average annual salary of $8,329.

CAB estimates that 1,527 commercial rate cases will be processed in Fiscal 1963, as compared with 1,437 expected by the end of the present fiscal year. The Board estimates it will conduct 105 formal route hearings, and 475 route proceedings which will not require formal hearings.

The balance of the workload remains at about the same level as that of Fiscal 1962 and 1961 with the exceptions of complaints handled by the Bureau of Enforcement. CAB estimates these complaints will reach 1,570 in the coming fiscal year. Accident investigations, on the basis of previous experience, can be expected to total 1,151 cases as compared with the expected 1,096 for Fiscal 1962.

High Court to Review Panagra Ownership

Washington—U.S. Supreme Court last week agreed to review a lower court decision requiring Pan American World Airways to divest itself of its 50% interest in Panagra.

At the same time, the Supreme Court agreed to hear a separate appeal by the Justice Department asking for a ruling that the 50% ownership of Panagra by W.R. Grace & Co. constitutes an unreasonable restraint of trade.

A U.S. District Court had found that PanAm's determination to suppress extension of Panagra operations into the U.S. constituted a monopoly and ordered the divesture. Anti-trust charges against Grace and Panagra were dismissed by the District Court.

In its appeal to the Supreme Court PanAm said that it would argue that other available relief would amply redress the only violation found or threatened and that the divesture order was an "abuse of the District Court's power."



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*DuPont Trademark

Sikorsky Aircraft DIVISION OF UNITED AIRCRAFT CORPORATION

FAA to Probe Finances of Supplementals

By David H Hoffman

Washington—Federal Aviation Agency has warned it will explore the financial foundation of each supplemental airline and judge the quality of its management before issuing the annual operating certificates that enable all such carriers to stay in business.

Explaining this policy change, FAA Administrator N. E. Halaby told a special House subcommittee it will be very hard to convince the Agency that the certificate of any given supplemental should be renewed in the public interest.

His testimony furnished the first clear indication that, in FAA's official thinking, there is a measurable relationship between airline economics and airline safety.

Entrusting any federal official with the power to judge the quality of a private company's management could prove dangerous, Halaby said. However, FAA has this power, and soon will begin weighing the capabilities of management personnel to assure safe and efficient operations, along with the skills of pilots, mechanics and flight engineers, Halaby told the three-man subcommittee.

New Legislation Sought

"We are going to ask for proof of financial responsibility before we issue or renew an operating certificate, on the ground that financial irresponsibility can't help but affect safety adversely, sooner or later," Halaby said. Because FAA's authority to act in these two areas needs legislative clarification, and because the agency needs new tools to control the itinerant supplementals, Halaby recommended Congress take the following steps:

- **Establish guidelines** that would broaden FAA's authority over airline financial and management matters. Halaby promised that even under existing powers more importance would be attached to an airline's operating history in deciding whether to renew its certificate. He also suggested that this could be made a joint FAA-Civil Aeronautics Board function.
- **Increase the civil penalty** that FAA can levy against airlines from the present limit of $1,000 per violation to $5,000 per violation. Legislation enabling FAA either to require insurance or "some other appropriate assurance" that carriers can meet the public liability usually arising from an accident also was urged by Halaby.
- **Give FAA power to revoke** the registration of an aircraft. As with an automobile, such registration offers proof of ownership and nationality. By authorizing FAA to revoke it, Congress would furnish the agency an effective tool with which to police U. S. airlines based abroad and engaging in international business with the sanction of a foreign government, Halaby said.

Headed by Rep. Porter Hardy, Jr. (D-Va.), the subcommittee of the House Armed Services Committee was appointed to examine military airlift procurement policies and the crash of a supplemental Imperial Airlines Constellation on Nov. 8 at Richmond. Of 77 who died in the accident, 74 were Army recruits. The accident caused FAA and CAB to broaden and intensify an investigation of the entire supplemental airline industry that began after a DC-6 operated by President Airlines, another supplemental, crashed near Shannon, Ireland, on Sept. 10, killing all 83 on board.

Violations Cited

Referring to the Imperial tragedy, Halaby testified: "I personally feel that this accident could have been prevented and that it was caused by the manner in which the aircraft was operated and maintained on that particular flight." At least 12 items, some "extremely serious," have been uncovered by FAA-CAB investigation of the Imperial crash, and these probably will be filed as violations against the airline and the surviving pilot, Halaby said. FAA records of Imperial's 13-year history also indicate that the company "tended to operate at all times with the very minimum of facilities and personnel" needed to meet Agency safety standards, Halaby said.

Data Called Misleading

Earlier in the four-day hearing, CAB Chairman Alan S. Boyd testified that Imperial had submitted misleading financial data and false statements to the Board, violated CAB's tariff regulations and used unorthodox methods to sell tickets. Halaby testified that Imperial scheduled uncertificated crew members on revenue flights, failed to comply with appropriate aircraft flight manuals, neglected to file flight plans, allowed unauthorized persons on the flight deck and disregarded an FAA rule that all mechanical discrepancies be listed in an aircraft's log.

CAB and FAA efforts to control the far-flung operations of the supplementals, according to Boyd and Halaby, have been hampered primarily by deficiencies in the Federal Aviation Act and by the failure of Congress to provide requested legislation and money.

On the CAB side, Boyd reported that the size of the Board's enforcement staff has averaged less than 14 positions

Supplemental Airlines History

September 1951—CAB begins Large Irregular Air Carrier Investigation to fix role of supplementals, select supplementals to receive authority and decide whether to grant authority by certificate or exemption.

November, 1955—CAB issues order finding supplementals a "separate class of carriers," awards them unlimited charter authority plus right to fly 10 trips per month between any two points. Authority granted to entire class by exemption pending final selection of carriers.

December, 1956—U. S. Court of Appeals, after declaring CAB's grant of authority illegal, holds its order will take effect 60 days after the final Board decision in the Large Irregular Carrier Case.

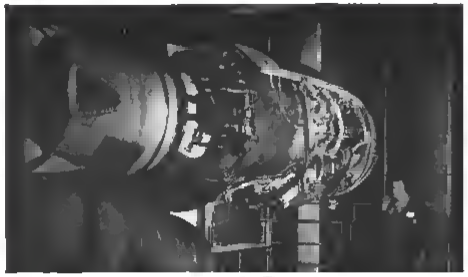
July, 1959—CAB finishes issuing temporary certificates of public convenience and necessity to 25 supplementals, granting them the same authority based on each airline's ability to perform and "disposition" to abide by the Federal Aviation Act of 1958. The Board "presumed" carriers then operating were capable of continued operations.

Apr. 7, 1960—U. S. District Court declares CAB certification of 25 supplementals "legally deficient" because the Board failed to name precise terminals, limited authority to 10 trips per month and did not set adequate fitness standards.

Apr. 28, 1960—CAB submits proposed legislation to bolster the Board's legal authority to issue supplemental certificates.

July, 1960—Congress, on the Senate's advice, enacts law authorizing CAB to continue supplemental operations until Mar. 14, 1962, thus affording the commerce committees of the two houses additional time to study the issue.

May, 1961—CAB re-submits proposed legislation to provide a permanent statutory base for the Board's authorization of supplemental air transportation. Bills passed by the Senate in August and by the House in September are now in conference committee.



Testing of complete Spey engine pod.

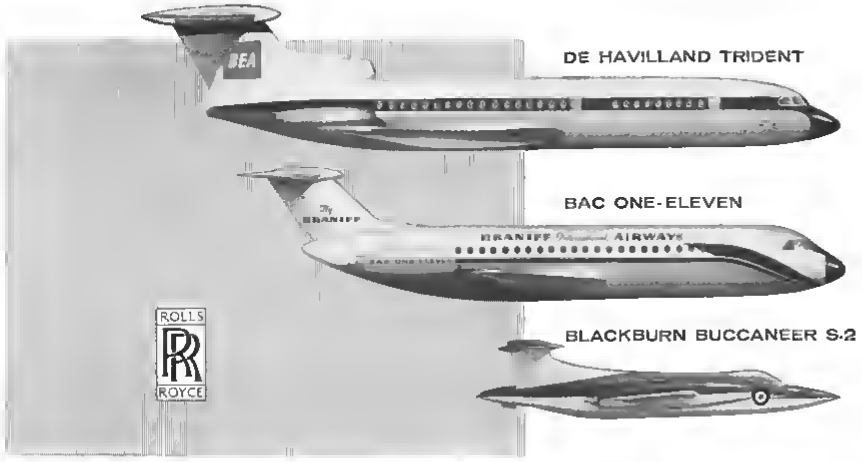
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Already chosen for two new airliners and a strike aircraft

The Spey by-pass jet is designed for operational economy—low fuel consumption, low maintenance costs and a long overhaul life. Speys will power the three-engined de Havilland Trident airliners ordered by British European Airways and the twin-engined British Aircraft Corporation One-Elevens on order for British United Airways and Braniff International Airways. Test flying has now started with the civil Spey and a military version is being developed, it will power the Blackburn Buccaneer S.2 strike aircraft.



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Airport Fees Settled

Washington — Trunklines serving Washington National Airport agreed last week to pay higher landing and rental fees under a Federal Aviation Agency proposal to bring the airport's charges closer to those of other major terminals (AW Jan. 8, p. 34).

Terms of the agreement retroactive to last July, raise landing fees from the 20 year-old level of seven cents per 1,000 lb. of maximum gross landing weight to 13 cents. Counter space rental will be increased from the average $2.40 per square foot to an average of $4.15, and hangar rental fees will increase to charges between 7½ cents and $1.19 per square foot, dependent upon the structure's location.

from its inception in 1946 through 1955. Although this staff now numbers 35, Boyd estimated that at least 60 would be needed to enforce Board rules and regulations.

More serious, from CAB's standpoint, is the lack of any civil penalty to levy against violators. Even in flagrant cases, the Board by law can only initiate a formal administrative proceeding for a cease-and-desist order or revocation or suspension of the guilty party's operating authority, request an appropriate U.S. attorney to institute a civil action for an injunction, or ask such an attorney to file a criminal action against the violator.

In all instances Boyd testified a court appeal stays the effect of any action taken by the Board. One supplemental which CAB has tried to "put out of business" since 1954, continued operating until last December merely by generating new appeals to the courts.

CAB first sought civil penalty legislation in 1950. Every year thereafter similar bills were proposed, but "the Congress in its wisdom, has leaned differently," Boyd told the subcommittee. House and Senate bills now in conference committee would grant CAB this authority.

A third area in which Boyd said the Board's regulatory power is undesirably limited concerns the transfer of supplemental airline ownership. If a supplemental's certificate of public convenience and necessity is sold, CAB must approve the transaction. CAB also exercises control over groups or individuals seeking to gain interlocking interests in more than one supplemental. But the Board cannot regulate the sale of stock in these corporations so they frequently change hands, Boyd said.

FAA now employs about 900 air carrier safety inspectors, has asked authority for 994 in its Fiscal 1963 budget, but feels that in order to guarantee safety a force of 1,500 to 2,000 would be needed, according to Halaby. In order to boost the quality of supplemental surveillance and inspections, he said, FAA has begun a review of its own techniques and a study of how best to utilize available manpower. To enhance supplemental air safety it is considering these key changes:

- **Assigning inspectors** at strategically placed stations even though no carrier uses such stations as an operating base.
- **Revising Part 42** of the Civil Air Regulations, under which supplementals operate, to clarify its intent and application.
- **Intensifying the central review** of all FAA field operations to ensure they are consistent.
- **Issuing regulations** to ensure that air line management personnel are adequate in quantity, quality and capability.
- **Terminating the certificate** of any company falling under control of an official from a company with a revoked certificate.
- **Suggesting that CAB hold FAA revocation** of an operating certificate reason for terminating the Board's own certificate.
- **Urging supplemental airlines** to establish centralized maintenance bases and training programs, thus aiding FAA inspectors.

Air France Buys 40% Interest in Air Algeric

Paris—Private interests which own France's largest private airline—Air Algerie—reportedly are selling off 40% of their share holdings to Air France.

Air France already has stock or management interest in North Africa's two other main carriers, Royal Air Maroc and Tunis Air. By acquiring 40% of Air Algerie, the French national carrier consolidates its dominant position in North Africa. It is unlikely, for example, that Air Algerie will now continue to play a role as a feeder to Trans World Airlines' transatlantic traffic. TWA is the U.S. carrier with rights in North Africa.

Stock sale may reflect recognition that Algeria is on the brink of independence. It is thus possible that private shareholders want to reduce their risk in the Algiers-headquartered airline. It is generally expected that Air Algerie's operation would be considerably altered in the event of Algerian independence (AW May 22, p. 43).

Air Algerie, set up in its present form in 1953, is entirely owned by private interests. Two largest stockholders are Compagnie Generale Transatlantique (French line) and Compagnie de Navigation Mixte, French shipping outfit. Air France has held no stock in the private carrier which operates mainly between Paris and Algerian points.

Proposed Credit Ban Criticized by Airlines

Washington—Eleven U.S. trunklines, all local service airlines and two U.S. international carriers have sharply criticized a Civil Aeronautics Board examiner's decision (AW Nov. 27, 1961, p. 39) which they say would force the industry to make sweeping revisions of its travel credit plans.

Ten of the trunklines, along with Pan American World Airways and Panagra, said the decision would gravely impair the ability of the industry to sustain itself. Western Air Lines also opposed the decision but with different reasoning.

Examiner Ralph T. Wiser's initial decision recommended changes in three vital areas of airline credit:

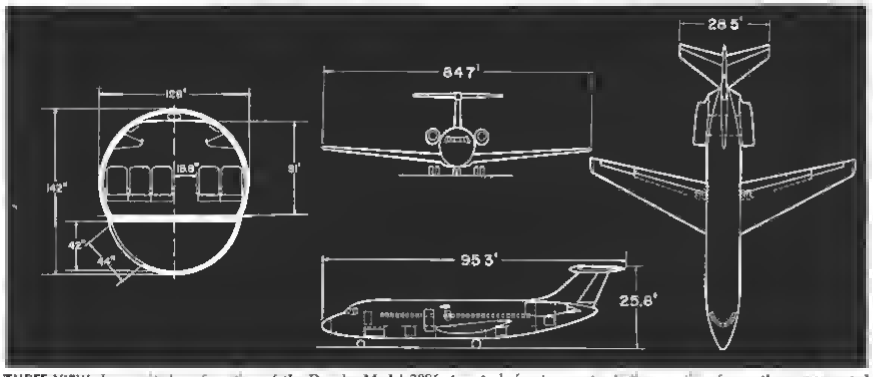
- **Universal Air Travel Plan** and individual credit plans for use on one airline. Examiner found that the $425 per customer deposit required by UATP, originally intended to protect carriers against non-payment of travel bills, was illegal unless carriers pay 5% interest annually on each deposit. The examiner also would require UATP carriers and carriers having their own credit plans to charge customers for the credit service. The fee would be 2% on the first billing, and upon failure to pay promptly, 1% for each rebilling.
- **Out-for-collection** and self-ticketing plans. Examiner Wiser found out-for-collection plans—ticketing by mail—and self ticketing were illegal unless bills are paid promptly. Accordingly, failure to pay for ticketing by mail promptly would subject the user to a 1% interest penalty if the bill were not paid within ten days after tickets were mailed. Continued failure to pay would cost the user an additional 1% on the total each month until paid.

Failure to pay promptly under a self-ticketing plan would have the same penalty, except the bill would have to be paid within five days after tickets are mailed. Under self ticketing plans, firms are provided with large blocks of tickets for use by their employes.

- **Noncarrier credit plans.** Credit plans such as Hilton Carte Blanche, American Express and Diner's Club were found illegal unless such companies are billed by the carrier within 15 days after ticketing. Credit companies would then have seven days to pay the carrier.

The trunklines and flag carriers told CAB that the examiner's decision, if approved, would undo 30 years of evolution in airline sales technique based on the hard facts of experience with customers.

Another fear of the carriers was that such restrictions on present credit plans would drive customers to travel agents who have their own credit plans.



THREE-VIEW shows initial configuration of the Douglas Model 2086 twin turbofan transport. Airline reaction favors the rear-mounted twin-engine layout for a short-range transport, but is not unanimous over the proposed size and fuselage diameter

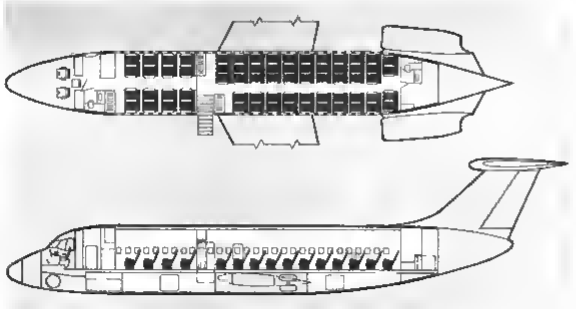
Douglas Canvasses Airlines on Small Jet

Douglas Aircraft Co. is showing renewed interest in its Model 2086 twin-turbofan transport project to the extent of canvassing potential airline customers for comments on its initial configuration.

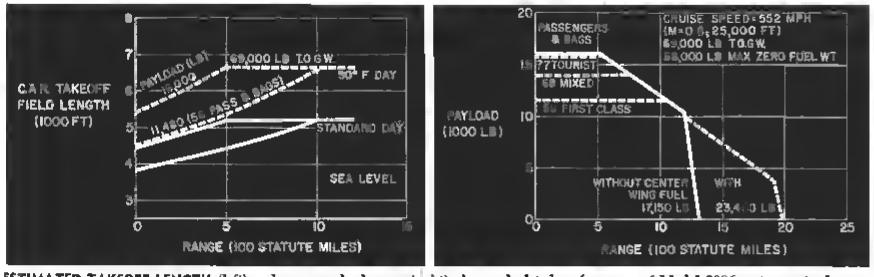
Airline opinion has been generally favorable to the twin rear-mounted engine layout, but has diverged over the size of the required airplane and its fuselage diameter, the latter affecting type of seating and passenger capacity.

The initial Douglas configuration calls for a 69,000-lb. airplane with capacity for 56 passengers in four-abreast seating, 77 passengers in three and two seating, or combinations of 18 first class and 49 coach, 20 first class and 44 coach, 24 first class and 39 coach or 16 first class and 52 coach.

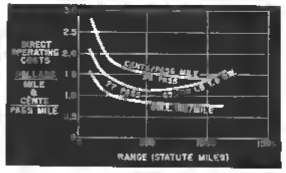
Eastern Air Lines, which has shown strong interest in this category (AW Nov. 6, p. 41), wants a somewhat smaller airplane, probably no more than 65,000 lb. gross weight. Some other



VARIOUS SEATING COMBINATIONS of four-abreast or three-and-two are offered. This one seats 65 passengers in a 16 first class and 52 coach configuration. The design also can provide for seating 56 passengers in four-abreast seating with 38 in. seat spacing. Full coach configuration using a three-and-two seating for most of the cabin with 34 in. spacing will seat 77 passengers. Aft galley removal and shifting the coat room forward would provide seating for three more.



ESTIMATED TAKEOFF LENGTH (left) and range payload curve (right) show calculated performance of Model 2086 in two critical areas.



MOST ECONOMICAL stage lengths begin about 300 mi. for the Model 2086.

points of difference between Eastern's preferences and the Douglas project—self-contained engine starting systems, for example—are not regarded as major points of controversy.

The Model 2086 project is not as active a program as the Douglas DC-9 program for a light-medium-range jet and currently is a relatively low-funded operation. But company support appears to be stronger with the beginning of the new year than it was last year.

The Douglas airplane design uses a moderately swept wing of 24 deg. with an area of 925 sq. ft. Douglas double slotted trailing edge flaps are provided, but leading edge devices are not. Horizontal stabilizer is fixed and all controls are manual, eliminating the need for complex systems to provide reversion from power to manual systems in case of power failure.

Single passenger door ahead of the wing includes a self-contained stair. Fuselage cross section is similar to the DC-8 with a lower lobe to provide for sufficient depth baggage stowage. A self-service luggage pullout rack contains 65 cu. ft. of storage space, and both luggage rack and passenger door are located on the left hand fuselage side so the right engine may be kept running during loading operation.

Powerplants proposed are two Pratt & Whitney JTF10A-2 turbofans, currently rated at 10,000 lb. thrust and a specific fuel consumption of .82 or two Rolls Royce Spey RB t63-2 engines rated at 10,400 lb. thrust and a specific fuel consumption of .78. Bare engine weight of the Spey is 100 lb. less than the JTF10's 2,300 lb., and slightly better performance of the airplane, calculated using the Pratt & Whitney engines could be assumed.

The Model 2086 is designed to operate economically at stage lengths of 300-500 mi. but is capable of operating at stage lengths of more than 1,000 mi.

Airport capabilities of the proposed airplane call for operation from a 5,000-ft. field on a 90° day with 56 first class passengers and baggage for a 300 mi. segment. Cruise speed is estimated at Mach .80-.81 at altitudes above 20,000 ft., and placard speed allowances are high enough to provide for sufficient climb and descent speeds for low block times needed for low operating costs.



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In flight view of de Havilland Rolls-Royce Spey powered Trident transport shows aircraft in clean configuration. Note engine grouping.

Trident to Begin Service With BEA Next Year

Trident is shown on final approach with gear and flaps extended. Aircraft is designed to land at up to 95% of gross take-off weight to ease refueling problems at intermediate stops. Design cruise speed is 606 mph. Flight take off is pictured at bottom (AW Jan. 15, p. 39).





SHORTLINES

► **Alitalia** reports it carried 47% more passengers between the U. S., Canada and Europe during 1961 than it did during 1960. Alitalia flew 86,738 passengers in both directions between North America and Europe last year, compared with 59,177 in 1960.

► **Aviation industry** has been invited to comment on the Feb. 25 expiration of a Federal Aviation Agency regulation permitting private experimentation with non-standard exterior aircraft lighting.

► **Continental Airlines** reports it flew 11.7 million cargo ton miles during 1961—a 35% increase over 1960.

► **FAA** will hold eight regional meetings with general aviation pilots in April. FAA will outline proposed changes in Civil Air Regulations governing general aviation resulting from FAA analysis of pilot comment during 88 regional meetings held last October. Meetings will be held at: Fairfax Airport, Kansas City, Kan., Apr. 13; Louisville Library Auditorium, Louisville, Ky., Apr. 17; Anchorage, Alaska, Apr. 18; Atlanta, Ga. (place to be announced later), Apr. 19; Departmental Auditorium, Washington, D. C., Apr. 24; Honolulu International Terminal Conference Room, Apr. 26; Anton Carter Airport, Ft. Worth, Tex., Apr. 28; Van Nuys Airport, Van Nuys, Calif., Apr. 28; Harrisburg (Pa.) State Airport, Apr. 30.

► **Japan Air Lines** plans a 33% expansion of its international route system this year, increasing the system to 47,606 mi. The airline also plans to increase seating capacity 50% on its domestic routes this year and to have an around-the-world network by 1964.

► **Pan American Airways** will introduce Boeing 321B turbofan powered aircraft on its summer schedules this year. Pan American says the jets make possible nonstop flights of 6,000 mi. with 125 passengers, five tons of cargo and a normal fuel reserve. The 321B is powered with Pratt & Whitney JT3D-3 turbofan engines.

► **Panagra** reports it flew a total of 229.5 million revenue passenger miles during 1961—a 16% increase over the previous year. Cargo ton miles during 1961 totaled 7.9 million—a 19% increase.

► **United Air Lines** will schedule round trip flights between Baltimore and Philadelphia and Baltimore and Atlanta with Caravelle equipment beginning Feb. 4.

AIRLINE OBSERVER

► Failure of North Atlantic carriers to approve group fares and revamped excursion fares in recent mail vote (AW Jan. 1, p. 38) does not necessarily kill the drive for lower fares on the North Atlantic. Differences over minor points again prevented unanimous approval of the mail vote and chances are strong that International Air Transport Assn. Director General Sir William Hildred will attempt to compromise these differences and conduct a new mail vote, the third in the current series.

► **Federal Aviation Agency, which never used its Fiscal 1962 budget authority to spend $8 million for a Douglas DC-8 and related equipment, has disclosed it will pay United Air Lines $592,124 this year to transition air carrier inspectors in the DC-8, Sud Caravelle and Vickers Viscount.** Award of contract indicated FAA would not seek to acquire all types of transports operated by major commercial carriers. Under its terms, FAA inspectors will receive 20 hr. of flight training in the DC-8 and Caravelle, 15 hr. in the Viscount and refresher training at the end of six months.

► An estimated 5,000 uniformed pilots are scheduled to participate in union demonstrations at 21 U. S. terminals on Jan. 22. About 33% of Airline Pilots Assn.'s active members agreed to spend 30 to 45 min. in each airport passing out union literature on the 20-month-old Southern Airways pilot strike. Ostensible purpose of the demonstration is to express appreciation for the appointment of a presidential fact-finding board to investigate the Southern deadlock. ALPA spokesmen said last week.

► **Aeroflot has introduced a 25% fare reduction for students buying round-trip tickets between their places of study and their home districts.** The discount, effective for a trial period between Jan. 1 and Apr. 1, is good on direct, nonstop jet or turboprop flights made by Tu-104s, Il-18s, An-10s and Tu-114s on all routes in the USSR. Return trip must be made within 45 days from the time of departure.

► Federal Aviation Agency and Civil Aeronautics Board attempts to persuade smaller airlines to centralize their operating, maintenance and training programs has caught the attention of the technical writing industry. At least two companies have offered to write and update a broad variety of standard operating manuals for the supplemental airlines. Such manuals must be approved by FAA on an individual basis.

► **Soviet Union has shipped three Il-14 transports to Cuba. They are now being reassembled in Cuba where they will replace Douglas DC-3 transports.** Cubans have had difficulty in obtaining spare parts for U.S.-built equipment. Ten additional Il-14s are slated for delivery to Cuba later this year.

► Highest Federal Aviation Agency and Civil Aeronautics Board priority has been accorded the problem of protecting passengers in survivable accidents since last summer's landing accident involving a United Air Lines DC-8 (AW July 17, p. 45). Armed with CAB statistical studies, FAA is strongly urging manufacturers to develop new equipment to minimize fire and structural hazards in crashes where deceleration forces are not necessarily fatal. Only 18 of 120 on board the DC-8 died when the jet veered off a runway at Denver, struck a survey truck and burst into flames. All 77 persons killed in the crash of the Imperial Airlines Constellation at Richmond Nov. 8 apparently died from carbon monoxide poisoning, not physical injuries.

► **Estimated 80% of the entire U. S. population—about 140 million persons of all ages—has never made an air trip, according to the recently issued Civil Aeronautics Board Handbook of Airline Statistics.** About 70% of the U. S. adult population has never flown, about 50% has never taken a bus trip and about 30% has never taken a rail trip, according to the handbook.

► Airlines serving Newark and Boston airports, faced with big increases in airport user charges, are refusing to pay under the new tariffs adopted at both airports. Instead, they have been sending payments based on the old charge scale. At Newark, carriers are insisting that the Port of New York Authority provide figures to justify the approximately 50% increase in landing fees. In the case of both airports, airlines feel the new fees are unreasonable and unjustified.



Titanium roll forged parts prior to welding into body-sections of Minuteman casings at Lycoming Division of the Avco Corporation

In Minuteman second stage

Titanium rocket case reduces weight 30%, boosts rigidity and reliability

Aerojet General Corporation has selected titanium for second stage Minuteman rocket motor cases as the fastest, most economical and reliable way of reducing the inert weight of this massive part.

Light-weight titanium (density 0.163 lb /cu in.) can be used in section sizes which prevent buckling failures. To achieve equal buckling resistance, the use of steel would impose a 30 percent weight penalty.

Titanium alloy grade Ti-6A1-4V has been selected because of its high strength (heat treatable to 160,000 psi tensile strength), its weldability and total reliability demonstrated both in elevated temperature applications (including 7000 jet engines) and cryogenic temperature applications (including 4000 pressure vessels).

Further, ample titanium mill capacity and the network of fabricators experienced in handling this grade guarantee a steady supply of parts should the program be accelerated. Since steel tooling and testing technologies are largely applicable, titanium has been introduced into the Minuteman program with no scheduling penalties.

Finally, the production, design, use, and fabrication history of titanium can be translated into the tough language of the military market place. The completed titanium cases cost slightly more than the alternate steel versions—a differential that vanishes under the impact of the 30 percent weight reduction titanium provides.

Titanium Metals Corporation of America hopes the following facts will put new light on the wide-spread potentials of titanium in all weight reduction programs. TMCA also hopes that, should titanium be helpful in meeting your weight bogeys, you will employ to full advantage the titanium technical service and production responsibility that is now provided only by TMCA. Here are some specifics, advanced by builders of Minuteman cases, that dictated use of titanium:

Ease of fabrication. Titanium is actually faster to weld than steel grades that can be used for motor cases. It is not as sensitive to weld porosity. There is no need for pre- and post-heating of the titanium weld area, thus eliminating distortion and loss of ductility which largely rule out repair welding when needed. Unlike steel, titanium can be machined after final heat treatment.

Reliability based on adequate testing. Minuteman program has included test firings of titanium cases—both third and second stages—so successful that cases were cleaned up, adjudged ready to fire again and actually put on display as representing "exhibit-quality" hardware. Another titanium case was recycled through hydrotest 25 times without failure.

Durability for long-term storage. Titanium rocket cases will not pit nor corrode, even in salt atmosphere. They have the structural integrity inherent only in homogeneous materials. They need no protection—be it paint or air conditioning. They are storable, under all atmospheric conditions, without possibility of catastrophic distortion.

In a recent test, sub-scale titanium cases were subjected to 60 days of salt spray and were completely unharmed. Steel cases failed after 7 to 14 days of this treatment.

Availability and lowering cost. A testimony to the predictability and availability of the metal, fabricators report that fixed price contracts are possible with titanium.

Titanium delivery times are generally short. For example, TMCA warehouses in Toronto, Ohio, and Los Angeles, California, provide metal on 24-hour shipment.

Structural rigidity. The titanium wall is 0.096 to 0.101 inches thick, which prevents the case from buckling under loads imposed during handling and maneuvering. To meet titanium's weight, a steel case would be 0.070-inch thick and compromise the case's resistance to buckling.

High strength-to-weight. The uniaxial strength-to-weight ratio of Ti-6A1-4V Minuteman cases is approximately 890,000 at 340°F. Biaxially it is 968,000.

This high strength-to-weight ratio is achieved with good retention of ductility—elongation in the range of 10 to 15%—and outstanding crack toleration.

Beta titanium coming into focus. Possessing an even higher strength-to-weight ratio—in excess of the "magic million"—beta titanium (Ti-13V-11Cr-3A1) is moving strongly into the motor case picture.

Army experience with beta: "highest performance". An announcement by Army Ordnance Missile Command called a beta titanium solid rocket case recently test-fired "the highest performance metallic propulsion unit pound-for-pound ever successfully fired in the United States." Case was 30% lighter than steel units, had superior durability and resistance to atmosphere corrosion.

How to use TMCA information resources. If your requirements are for a light-weight structure, combining rigidity and strength at extremes in temperature, while retaining toughness and corrosion immunity—or if you need information on titanium fabrication techniques—competent fabricators, contact TMCA's Technical Service Department. It's staffed by able materials men—men who talk your language.

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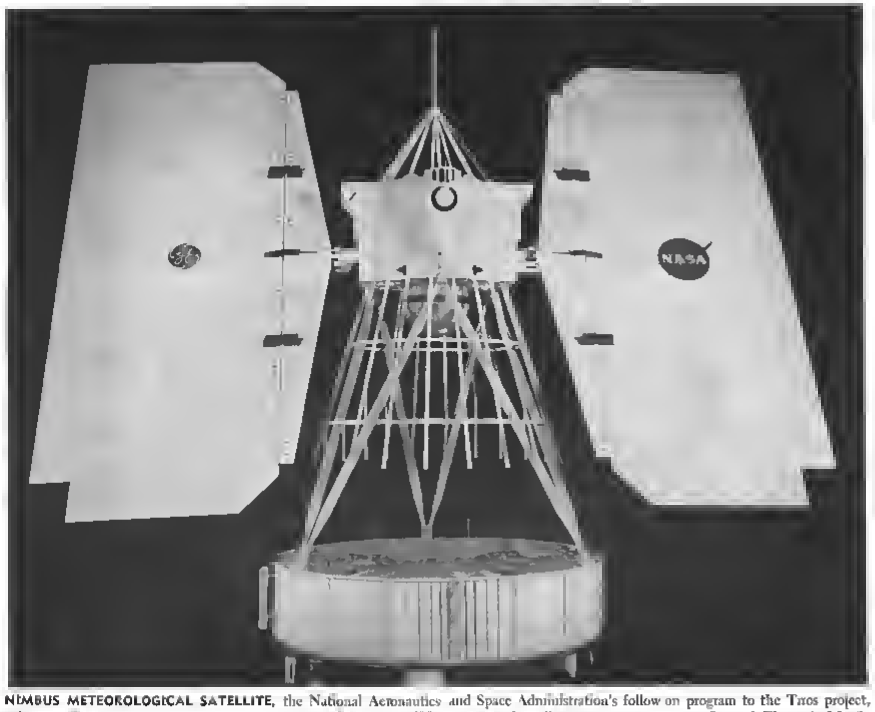
Titanium cylindrical sections for Minuteman second stage case are roll-forged from forged rings to accurate, uniform wall thickness and then are finish-machined. It is possible to obtain increased rigidity with titanium at no weight penalty.



Titanium sections are welded together "open-air", by inert gas shielded, tungsten arc methods. Titanium welds are as strong or stronger than parent metal, are less sensitive than steel to weld porosity and need no pre- or post-heating.



Titanium cases in various states of completion. End closures are 3-D machined from closed die forgings. Titanium fabrication is lending itself to full-scale production with few changes in capital equipment, and reliable delivery.



NIMBUS METEOROLOGICAL SATELLITE, the National Aeronautics and Space Administration's follow-on program to the Tiros project, will transmit about 1,300 cloud cover photographs daily from a 600 naut mi orbit. Principal contractors are General Electric's Missile and Space Vehicle Department and Radio Corp. of America.

Nimbus Undergoes Tough Prelaunch Tests

By George Alexander

Valley Forge, Pa.—Nimbus meteorological satellite, which will become the operational outgrowth of the experimental Tiros project is moving through a rigorous test program at the new General Electric Missile and Space Vehicle Department center here in preparation for a first orbital flight expected late this year.

Bigger, heavier and carrying more advanced and more sophisticated systems than Tiros, the National Aeronautics and Space Administration's Nimbus will be earth oriented and stabilized on all three axes in a polar orbit. The research and development Tiros, which proved the value of a meteorological satellite (AW Oct. 2, p. 70), was spin-stabilized on one axis, partially stabilized on a second and space-oriented.

NASA plans one Nimbus flight in 1962, two in 1963 and one in 1964. Additional spacecraft, leading to an operational satellite system, will be ordered as the first several research and development Nimbus vehicles indicate overall systems performance.

Nimbus Manager

NASA's Goddard Space Flight Center, Aeronomy and Meteorology Division, Greenbelt, Md., is managing the Nimbus program in the role of prime contractor with construction of the spacecraft and the attitude control system, systems integration and test being charged to General Electric's Missile and Space Vehicle Department. Development of the television cameras, recorders, power sources and related airborne and ground equipment is the responsibility of Radio Corp. of America's Astro-Electronics Division, Princeton, N. J.

Nimbus is presently encountering a problem not uncommon to the growth phase of a satellite system—overweight. NASA's design specified a weight of 650 lb. for the fully equipped and instrumented satellite. General Electric and NASA engineers estimate that if all subsystems called for in the design were placed aboard the spacecraft now, the scales would register around 725-730 lb.

Since the basic design involves considerable redundancy of parts, circuits and some subsystems to ensure a high level of reliability during orbital operation, NASA has decided to develop the first Nimbus spacecraft in a stripped-down configuration—by eliminating some redundant units—while at the same time trying to reduce the weight of subsystems being assembled and integrated aboard other vehicles now coming down the line.

NASA program managers feel that this trimmed Nimbus, designated Nimbus A, will nonetheless provide a thorough flight test of the entire system and all major subsystems. Weight-cutting can be performed concurrently with program development, thus saving time.

Nimbus A will carry only one RCA camera pack, in place of the two identical redundant television units required in the spacecraft's design. It also lacks one photographic tape recorder, one battery, the low-resolution infrared experiment and some redundant circuitry. In this trimmed form, Nimbus A still weighs about 630 lb. and might even reach 650 lb. by launch time.

Nimbus Components

The satellite stands 114.15-in. tall, from bottom to antenna top, and consists of these two major units:

- **Sensory ring,** a 57.12-in. dia., 13-in. deep doughnut-shaped container which houses the television cameras in the center of the ring and the infrared experiments, telemetry transmitters, batteries and related electronic equipment in compartments around the ring.
- **Attitude control system,** a hexagonal-shaped unit 17 in. deep and 22 in. across, mounted on three inverted-V truss supports 47.5 in. above the sensory ring. (For details on the attitude control system, see AW July 10, p. 77). Solar paddles, 96 in. tall and 38.5 in. wide, are mounted on a shaft through the attitude control system.

The sensory ring is composed of 18 compartments, 8 in. deep, 13 in. tall and 6 in. wide, into which the modularized subsystems and assemblies are inserted. All modules are 6 in. wide, some are either 6.5 in. or 13 in. tall and either 2 in., 4 in., 6 in. or 8 in. deep.

Modules are positioned around the ring according to their temperature profile—those units dissipating large amounts of heat are placed on the sides of the ring which never look directly into the sun and small heat producers are placed on the ring fore and aft of the satellite's line of motion.

With 12 o'clock taken as the rearmost position on the ring, the modules are located in compartments around the ring in this clockwise arrangement: (1) transmitter, (2) clock (programmer), (3) battery (all batteries are nickel-cadmium), (4) multiplexer, (5) transmitter, (6) battery, (7) electronic modules, (8) battery, (9) at the foremost compartment, pulse-code-modulated (PCM) multicolor, (10) tape recorder electronics, beacon and telemetry transmitter, (11) telemetry recorder and battery, (12) battery electronics, (13) medium resolution infrared experiment recorder and battery, (14) electronic modules, recorder and transmitter, (15) battery, (16) camera electronics, (17) battery and (18) command receiver, sequence timer, power control switch and multiplexer.

The ring is designed for an isothermal balance of 25C, ±5C, and the modularized assemblies have been tested extensively to determine their equilibrium temperatures. Temperature control is maintained both by four shutters on each compartment, which—when opened—permit radiant cooling, and by lining the compartments with multilayers of tissue glass, aluminized Mylar and other insulating material.

Shutters are activated pneumatically. A gas-filled tube snaked in and around the modules in each compartment expands as the modules heat up, and drives a bellows which then moves the shutters. Shutters, positioned around the ring so that the sun does not directly impinge on any module, are equipped with a mechanical fail-safe device. In the event of gas leakage or bellows failure, the shutters on that particular compartment would move to the mid-range position and stick there, thus preventing overheating of the modules.

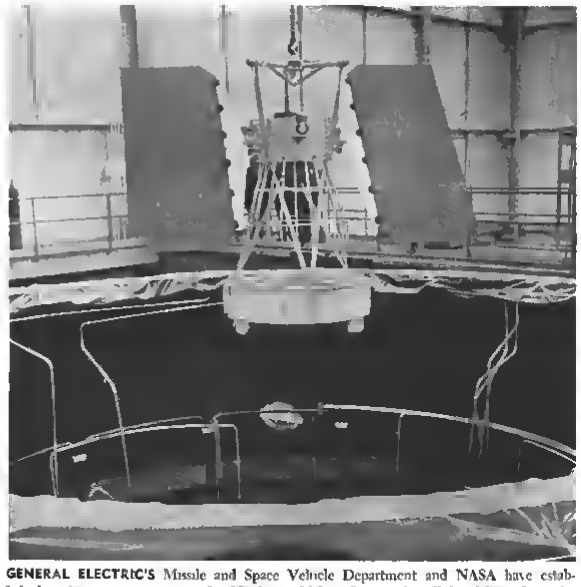
In the event of module failure in certain heat-critical compartments, the Nimbus spacecraft can be commanded from the ground to turn on resistive loads that simulate the power dissipation of the actual module and thus maintain the isothermal balance of the sensory ring.

Nimbus, with the exception of Nimbus-A, will carry two camera packs, each pack containing three 37-deg. field-of-view videcon cameras. These camera packs along with their corresponding magnetic tape recorders and an infrared experiment, are mounted on an H-frame inside the sensory ring.

Television System

The television system, called AVCS for Advanced Videcon Camera System by RCA, is more advanced than that carried aboard Tiros satellites. The three cameras in each pack are positioned side-by-side in a row at right angles to the satellite's line of motion. The end cameras in each pack are canted at a slight angle to the center camera so that their field-of-view overlaps the middle view by 2 deg. on each side. Panoramic look-angle of the pack is therefore 105 deg., covering a strip of ground—from an altitude of 600 naut. mi.—approximately 1,500 naut. mi. wide and 350 naut. mi. deep.

Each videcon camera has an 800-



GENERAL ELECTRIC'S Missile and Space Vehicle Department and NASA have established a rigorous test program for Nimbus vehicles. Spacecraft will be delivered to the civilian space agency only after they have successfully completed two months continuous operation in a vacuum chamber.

New Raytheon Cybertron learns like a man, thinks like a woman, decides like an expert

Unprecedented in concept and ability, Raytheon's Cybertron is a machine that can learn to handle non-formula problems normally performed by carefully trained men. It can be used to analyze electrocardiograms, discriminate between real and false sonar echos . . . even promises to provide a new technique for predicting the weather

Like a woman, Cybertron is constantly changing its mind — but only to adjust its memorized information in the light of new data. Once the technique for a solution to a problem has been learned, the machine's results can be utilized to design less complex, lower cost machines

Cybertron is an astounding electronic simulation of man's learning process

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RAYTHEON



line scan per frame, compared with the 500-line scan of Tiros, and this should give a ground resolution of about 5 mi per scan line. Each camera also carries as auxiliary equipment:

• **Automatic iris control.** Aperture of the camera lens varies as a function of the sun's angle—narrowed to the f/16 position when the satellite passes over the equator and wide open to the f/4 position over the poles—so as to provide an optimum and even amount of light at all times. A servo motor controls the opening of the iris, receiving its signals from a potentiometer on the drive shaft of the solar paddles. As the paddles rotate toward the sun, the potentiometer picks off the angular motion of the shaft and relays a signal to the servo, which then either opens or closes the iris.

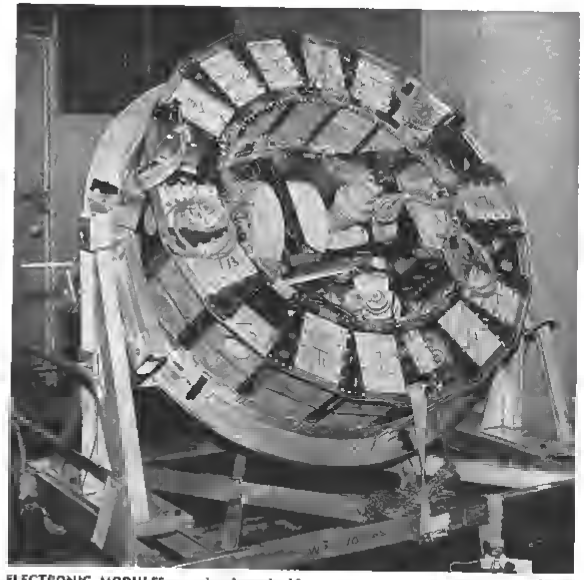
• **Automatic gray-scale calibration.** This device flashes a light beam through a prism masked with materials of known varying opaqueness onto the lens of each camera. Similar to the test pattern sent out by commercial television stations prior to broadcasting, this graded pattern is recorded by the camera just before the camera takes a picture of clouds below. Transmitted to the ground stations along with the cloud cover photograph, the pattern appears on photographic prints as a wedge of 12 graduated gray levels on the bottom of the picture. Contrast of the cloud cover photo can then be made against this known gray scale.

Each videcon camera takes 32 pictures per orbit, or 96 photos per camera pack per orbit. There are 14 orbits per day and so Nimbus should return about 1,300 cloud cover photographs daily. NASA selected Fairbanks, Alaska, as the site of the readout station because this location captures the maximum possible number of orbits—10—each day. During those four orbits, 10, 11, 12 and 13, where Nimbus is not within range of Fairbanks, the television pictures are stored in magnetic tape recorders, one per camera pack. Each four-channel recorder has a two-orbit storage capacity for each camera or 192 photographs per recorder. Since Nimbus-A will be shy one recorder, it consequently will miss two orbits of data daily. The recorders also will store photos taken where direct readout of the cameras—i.e., bypassing the recorders—to the Fairbanks station is not possible. Tapes are wiped clean after every readout.

NASA is expected to establish a second station on the East Coast of the United States so as to have a complete readout capability on the data gathered during all orbits.

Photographs are recorded on separate subcarrier frequencies on magnetic tape. When playback is commanded by the Fairbanks station, the data are frequency multiplexed onto one carrier wave for transmission.

Ground station recorders demultiplex the signal received from Nimbus and then relay the three subcarrier video frequencies to a high quality kinescope recorder, which demodulates the signals and, selecting one or another, develops quick-look films. Or, after being demultiplexed but not demodulated, the subcarrier signals are fed into sepa-

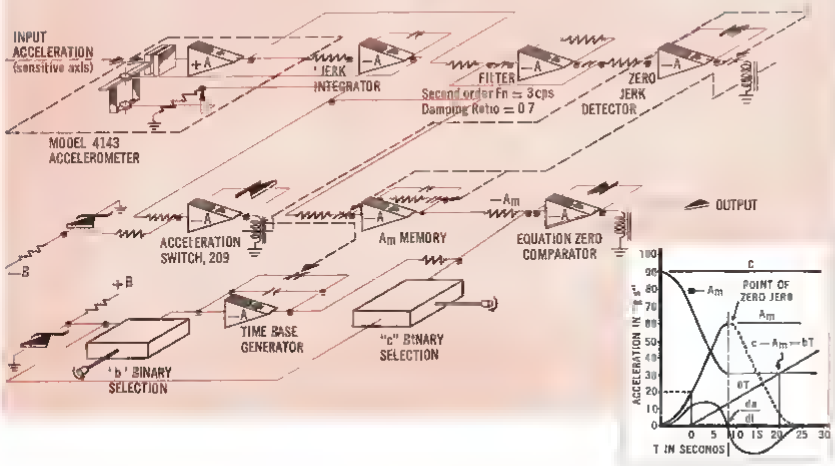


ELECTRONIC MODULES are placed inside 18 compartments around this ring, which is the lower unit of Nimbus. One camera pack is visible in the lower half of the area within the ring. This particular sensory ring was used in the vibration test model. Nimbus is designed to take loads of 15g acceleration and 12g vibration.



NIMBUS TEST MODEL is moved by overhead crane at General Electric Missile and Space Vehicle Department's new center at Valley Forge, Pa., to a space simulator. Spacecraft will be tested in both its own specially designed 39 ft. dia. chamber and in a 32 ft. dia., 54 ft. high space environment simulation laboratory.

unctional Diagram of Donner Accelerometer Timer Switch Basically an airborne computer designed to solve a specific equation, this Donner device consists of a force balance accelerometer whose output feeds to a tachometer for determination of peak acceleration (jerk (da/dt)) is the first derivative of acceleration) From the tachometer the signal passes through a filter and to a zero-jerk detector which closes a switch at the peak acceleration Other units in the computer are a peak acceleration memory a 20 g acceleration switch which starts a time base generator and prevents the zero jerk detector from operating before a correct solution is possible 'b' and 'c' solution binary units allow 64 values of 'c' and 'b' to be selected within the operating range and an equation zero comparator which algebraically sums the output of the maximum acceleration memory circuit, time base multiplied by 'b' and 'c' circuit to close the relay output when $0T = c - A_m$ The curve below illustrates the equation and the fact that peak acceleration occurs at zero jerk



How to Solve a Flight Equation

New Donner Airborne Analog Computer solves equation $bT=c-A_m$

where b = predetermined constant, T = time in seconds, c = predetermined constant, and A_m = peak acceleration achieved.

Causing a missile event to occur at just the right time and place in space is one of the critical problems faced by the control engineer. The programming device must be light, accurate, strong and, above all, reliable in severe environments.

When Donner engineers were confronted with this problem, they came up with a fixed purpose airborne analog computer known more specifically as an acceleration summing switch. The summing switch is a "thinking" device which responds to a particular environmental stimulus. Thinking for the vehicle, the switch measures time, multiplies it by a preset constant, equates the product to the memorized peak acceleration subtracted from a constant and when the sum reaches a predetermined value, actuates a relay. Such a point occurs during decreasing acceleration and is dependant on the magnitude of peak acceleration.

In solving this problem, Donner engineers combined their experience with computer techniques and servo force balance accelerometers. The device illustrated is all solid state.



Acceleration Summing Switch. This remarkable small computer is approximately 4" high and 2½" across. The two knobs on the top are used to set in 'b' and 'c' solutions of the equation

COMPLETE TECHNICAL INFORMATION AVAILABLE
If you would like more information about this interesting application of computer and transducer techniques, our Mr. Stephen P. Cuff has prepared a technical discussion which he will be happy to send along. Please write Mr. Cuff at Donner Scientific.

DONNER SCIENTIFIC COMPANY
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CONCORD, CALIFORNIA

rate channels of a tape recorder and then at an 8-to-1 reduction speed, printed out on facsimile machines for permanent hard prints.

The television cameras have a shutter speed of 40 milliseconds and are rated at about 12 watts each. Total AVCS system has an average power rating during daytime operation of about 15 watts. Signal-to-noise ratio (peak to peak signal root mean square) is 30 db.

On the launch vehicle an adapter section containing optical calibration and checkout equipment will be fitted between the Agena B and the Nimbus spacecraft. Equipment in this section, which measures 60.02 in. in diameter and is 24 in. tall will draw power from the launch umbilical and will provide both performance characteristics on the cameras up to the moment of launch and go, no-go signals on the equipment. At liftoff, the umbilical disconnects and the checkout equipment is turned off.

Radio Corp. of America's electrostatic tape camera (AW Nov. 14, 1960, p. 68) a panoramic scanner that would replace the three videcon units, is still in research and development and will not be flown until later Nimbus launches.

Originally, NASA's Nimbus design called for three infrared experiments. They were:

- **High resolution unit**, measuring the band between 3.4 and 4.2 microns for nighttime cloud coverage.
- **Medium resolution unit**, measuring water vapor absorption at 6.7 microns; radiation at 0.55 and 0.8 microns; albedo radiation from 0.2 to 5.0 microns; terrestrial radiation at 5 to 60 microns and the atmospheric window at 8 to 13 microns.
- **Low resolution unit**, measuring the heat balance of the area covered by the television cameras and reflected solar radiation from the earth between 0.25 and 40 microns and thermal radiation from 4 to 40 microns.

Because of weight problems and its present state of development the low resolution infrared experiment will not be carried aboard Nimbus A. The medium and high resolution infrared experiments are mounted on the bottom of the sensory ring and, like the television camera packs are equipped with their separate tape recorders.

Nimbus carries five separate transmission systems including frequency modulated (FM) pulse-code modulated (PCM) and amplitude modulated (AM) transmitters. Television pictures are transmitted over a S-band antenna, at a frequency of approximately 1,700 mc. Nimbus A will carry only one such antenna having only one camera pack, but future Nimbus spacecraft will carry two, and with two television packs will be capable of hooking up any combination of cameras in either pack with either recorder.

An antenna system consisting of four quadriloop antennas is spotted around the sides of the ring for telemetry transmission of module performance. Transmissions over this antenna system at about 136-mc. are phased so as to provide an omnidirectional pattern and are pulse-code-modulated. Two additional quadriloop antennas for transmission of infrared experiment data are in the same bandwidth as the other four and all transmissions over these antennas are compatible with the Minitrack system.

When out of range of the Fairbanks station the PCM transmitter sends out a digital time code signal for tracking purposes.

The command antenna, over which commands are issued to the Nimbus spacecraft, is located around the attitude control system and provides about 128 channels for conversation with the satellite.

Launch Sequence

Nimbus will be placed in orbit by a Thor Agena B vehicle launched from Pacific Missile Range. Since specified orbit is a 600 naut. mi. circle the Lockheed-built Agena B will be called upon for two ignitions. Present plans call for Nimbus A to be placed in a 500 naut. mi. orbit, the 100 mi. difference being allowed as a compensating margin for the vehicle's final weight.

At approximately 80 naut. mi. altitude the shroud surrounding the Nimbus spacecraft is jettisoned so that the acceleration of the launch vehicle will force the fairing away from the satellite.

After Thor burnout, the Agena B is ignited and places the spacecraft in a preliminary orbit. The Agena B is then shut down and, with the Nimbus still attached, coasts for several minutes. The upper stage's restartible engine, developed and built by Bell Aerosystems Co., is then ignited a second time and the Nimbus is injected into a true circular orbit.

The Nimbus is then separated from the Agena B and adapter section by springs which impart a velocity of about 5 fps. to the spacecraft. The Agena B is yawed 180 deg. and kicked away from the satellite toward the earth by a retro rocket.

Separation of the satellite from the Agena stage causes a switch to be turned on which in turn activates the programmer. At separation plus 2 sec., the programmer simultaneously commands the solar paddles to unfold and the attitude control system to execute a blind pitch up maneuver.

At separation plus 14 sec., the pad



Engineered Environment

Looking for a complete, portable facility with all environmental safeguards? A good example from Nature is the bagworm's portable "log cabin." It's built water-tight, insulated against heat and cold, and lined with spun silk. It hangs from a branch by silken threads. To move it elsewhere, the bagworm just cuts the moorings and carries his cabin off to another feeding place.

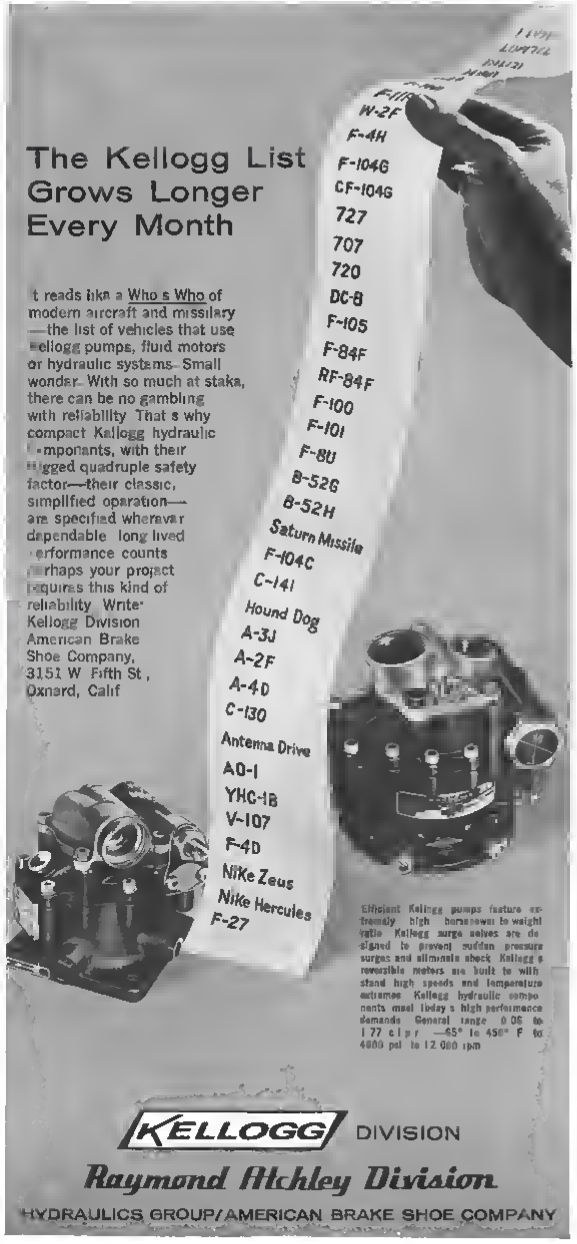
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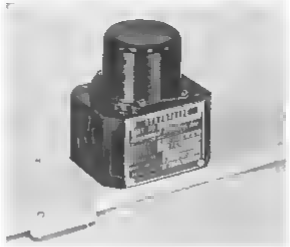
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Unique Atchley Servovalve Proves Answer to Fluid Contamination Problems

The Atchley *Jet-Pipe* servovalve has proved its ability to virtually eliminate contamination as a problem — or even as a factor. In doing so, the valve has made possible appreciably higher hydraulic system reliability.

When originally developed by the Raymond Atchley Division of the American Brake Shoe Company, this unique servovalve was subjected to five independent tests at unprecedented levels of contamination — 25 times greater, in fact, than ever before thought feasible. The test system actually failed because of the severity of the contaminants, but the valve nevertheless demonstrated its ability to perform continuously and with complete reliability.



The Atchley servovalves can operate with contaminants as large as 200 microns without malfunction.

Atchley servovalves, with their exclusive *Jet-Pipe* feature, now play an important role in major airborne and space electrohydraulic systems. The Atchley valve provides positive automatic control without requiring costly, painstaking contamination-control measures.

Other Raymond Atchley products are servoamplifiers, torque motors, and complete servo systems for aerospace, ground support, and other military applications. In the design and development of complete systems, the Atchley Division cooperates with other members of American Brake Shoe Company's Hydraulics Group such as the Kellogg Division (manufacturers of pumps and other air- and space-borne hydraulic equipment). Also available for consultation are American Brake Shoe Company's Hydrodynamics Laboratory in Columbus, Ohio, and the corporate Research Center in Mahwah, New Jersey.

Raymond Atchley Division is at 2231 S. Barrington Avenue, Los Angeles 64, California.

dules—fitted with 5,740 solar cells each—are fully extended and at plus 22 sec., the attitude control system has erected the spacecraft to an upright position along local vertical, and has stabilized Nimbus along pitch and roll axes.

NASA and GE had intended initially to stabilize the spacecraft on its yaw axis from signals generated by the coarse sun sensor. This approach was discarded when NASA considered the possibility that, should the Agena be rolling slightly at time of separation, the spacecraft also would roll and, coupled with the blind pitch-up maneuver, might cause the vehicle to move along the line of motion in a backside-first position. Nimbus has a definite front and back. NASA and GE engineers emphasize, for the solar paddles are geared to move in a clockwise manner and always attempt to maintain a high noon position relative to the sun.

While the attitude control system could turn Nimbus around, if the condition described above did occur the project managers feel that such correction would expend a considerable amount of the limited gas supply for the spacecraft's reaction jets.

Launch sequence now calls for the spacecraft to enter the earth's shadow still yaw-unstabilized and there the rate integrating gyro will finally bring the Nimbus down to its design objective of less than one degree deviation.

Orbit of Nimbus is 80.45 ±0.5 deg. retrograde (contrary to earth's rotation) so that the slightly greater gravitational pull of the equator will warp the orbital plane and, in effect, drag it to make the plane coincide with the angular rate of the earth around the sun. Orbital period will be about 109 min.

System Tests

Assemblies and subsystems are now undergoing individual and integrated-system tests. GE's Missile and Space Vehicle Department presently is finishing construction of a prototype Nimbus that will be identical with flight spacecraft but which will be used only for ground testing. The company has three flight Nimbus vehicles on the assembly line and has built three separate models for vibration, thermal and separation (from the upper stage) testing.

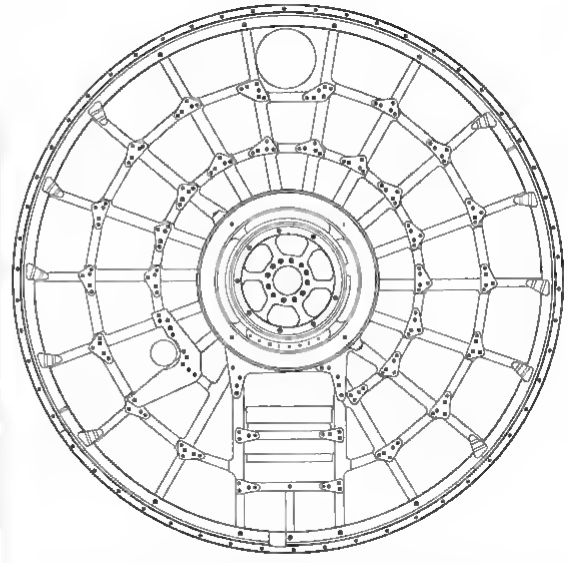
The prototype Nimbus is scheduled to enter GE's 39-ft.-dia. space simulator, built specially for the Nimbus program, sometime around the middle of this year. There it will be mounted on a gas-bearing (for a picture of a similar type test rig see AW Sept. 11, p. 63) which is dynamically balanced to 0.1 in.-oz. The black-wall chamber includes a simulated solar source, simulated earth horizon and a retractable, pylon-mounted calibration adapter section which can be moved forward to mate with the spacecraft's sensory ring for testing and alignment of the Nimbus camera subsystems.

Placed inside the chamber evacuated to 10^{-5} mm. of Mercury, the Nimbus is to be exercised continuously for two months. Failure of any subsystem, assembly or part will require withdrawal of the spacecraft, replacement of the unit and reinsertion of the Nimbus into the space chamber for another two-month run. GE will not deliver Nimbus satellites to NASA until they have successfully completed a two-month tour in the space chamber, nor does GE plan to perform any in-field repair of vehicles already delivered.

Nimbus spacecraft which develop problems at a launch site will be returned to GE's Missile and Space Vehicle Department for correction.

The six-month lifetime of Nimbus is determined by the limited gas supply in the attitude control system. Reliability testing and quality control of all parts, circuits and assemblies, however, are designed to meet stringent NASA specifications and to provide an electronic lifetime of several years. Should the satellite's lifetime be extended by an increased gas capacity, the spacecraft's performance standards will be adequate to the task and will not have to be upgraded.

WHO BUILT TIROS?



RCA designed the weather satellite. Lavelle built the complex 18-sided structure to carry its active components. Lavelle specializes in the precision fabrication of sheet metal structures for missiles and space vehicles, aircraft and ground support equipment. Major contractors know it. Write for brochure detailing Lavelle quality controlled services. Engineering / Production Planning / Sheet Metal Forming / Welding / Machining / Metal Finishing.

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OAO Star Trackers Have High Reliability

First design details on Kollsman Instrument Corp's star trackers, being developed for the Grumman Orbiting Astronomical Observatory, show calculated system errors of less than half a minute of arc, a reliability factor of 0.915 over a year's operation, and a total power drain of less than 0.1 watts per tracker.

Six of the Kollsman units will be mounted in the OAO in a way that three stars can be tracked at all times for precise pointing of the experimental packages that are contained in the observatory.

Error signals generated in the trackers will be used to change the orientation of the OAO by means of the General Electric Co. stabilization and control system.

Kollsman is subcontractor to GE's Missile and Space Vehicle Dept. in the OAO program. In turn, GE is a principal subcontractor to Grumman Aircraft Engineering Corp., prime OAO contractor to the National Aeronautics and Space Administration's Goddard Space Flight Center.

Stars provide a convenient set of reference points for orientation in space. Optical methods can measure small angles precisely.

Thus the natural combination of convenient references and accurate measuring techniques leads directly to the use of star trackers for positioning a space vehicle.

With two degrees of freedom in the tracker a reference plane in the vehicle can be oriented with respect to the celestial body being tracked. Two or more trackers will give two or more angular positions of the stars with respect to the reference plane, so that the information generated can be used to determine the attitude of the vehicle, or conversely, to align it to a precomputed attitude.

Any one of the six trackers can be positioned remotely by command from the ground. Each will be able to acquire and track automatically any star of second magnitude or brighter.

(Star magnitude is a measure of brightness originally measured on a scale of one to six by Hipparchus, a Greek astronomer in about 120 B.C. First magnitude was the brightest, sixth magnitude the faintest star he could see with the naked eye. Current magnitude system classification extends both upward and downward from that original scale. Now, a difference of five magnitudes corresponds to a hundred-to-one ratio of brightnesses; a first magnitude star is a little more than 2.5 times as bright as a second magnitude star.)

Design Standards

Kollsman engineers faced with the problem of designing trackers to new standards of accuracy and reliability chose to avoid moving parts as much as possible, to derate all the components as far down the scale as possible, and to use proven techniques to maintain performance stability.

They devised a system which is basically an automatic photo-electric star tracker tied to separate electronic systems. The tracker itself is a photo-electrically sensitive scanning telescope, gimbal-mounted, and enclosed in a hermetically sealed housing which carries the viewing mirror. The window is big enough so that the telescope can track through a 120-deg. solid cone whose axis is normal to the window.

The telescope has two sets of optics and scanners tied to a single photo sensor. Each optics-scanner combination gives a star direction, one with reference to the inner gimbal axis and the other with reference to the outer gimbal axis. Each of the axes has a d-c torque motor drive and a precision angle pickoff. Motors respond either to command or to tracker error signal; the pickoffs then measure the gimbal angles.

Light from the tracked star enters the system and is detected by a paraboloid mirror with an equivalent "lens speed" of f/1.6. Ultimately, the tracker will measure the error between the center of the field of view of the telescope and the center of gravity of the star image.

The optical reflecting system focuses the light from the star at each of two vibrating-reed scanners which modulate the light by means of resonant vibrations of the reeds. The light is interrupted twice for each cycle of vibratory motion. If the star image moves off axis, the vibrating reed modulation produces an unsymmetrical signal which contains the fundamental frequency of the reed drive. If the star moves in the opposite direction, the same signal is produced, but with an opposite phase. These signals are suitable for servo positioning and star recognition.

Signals Collected

The modulated signals from the star image are collected after passing through the reeds and superimposed on a photomultiplier which converts the modulated light into an electrical signal. This is amplified and detected; the detector stage output gives both the star recognition signal and error signals for both inner and outer gimbal servo amplifiers.

The reed scanners are independent and vibrate at different frequencies, one at 350 and the other at 450 cps. Each of these scanners will produce an electrical signal in each axis of rotation proportional to the distance between the star image and the center of the telescope field. That signal is amplified in a pre-amplifier and fed to four tuned amplifiers, two tuned to the reed scanner fundamentals and two tuned to twice those frequencies. Outputs are fed to detectors, which add the outputs in series to produce a voltage.

When the star image is centered, both the fundamental frequency signals go to zero, because the tracking system is a nulling type. When the star image is near the center of the field of view, the scanners develop twice the reed drive frequency, and therefore generate a voltage when the tracker is nulled.

This added voltage signal is fed to a star-presence detector which has an established threshold level, above that level the detector signals the presence of a star in the tracker.

The voltage is also fed to the high-voltage power supply of the photomultiplier as a control, so that the power supply will feed a variable d-c voltage to the photomultiplier to maintain a constant signal output over a range of star brightnesses.

Fed to Demodulators

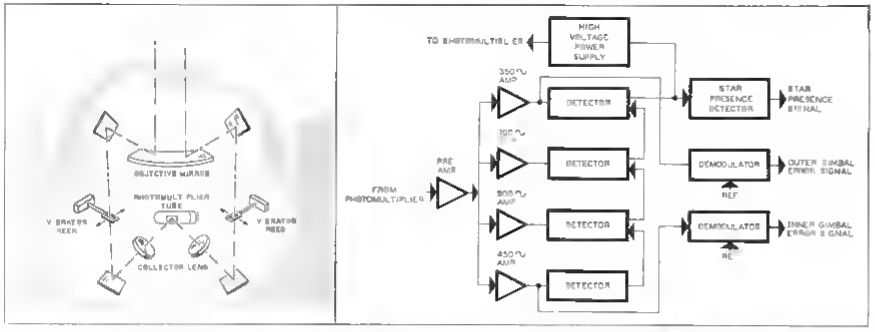
Outputs from the fundamental-frequency tuned amplifiers are also fed to demodulators to produce error signals to drive inner and outer gimbals.

Total permissible error in the system is 30 sec of arc composite, or 22 sec of arc per axis. Initial error, due to precision of alignment only, is estimated at two seconds of arc. The reed stability within a temperature range from −55C to 90C will also be within two seconds of arc, according to tests made at Kollsman.

Pointing accuracy of the tracking telescope system is expected to be within five seconds of arc. Errors in the threshold response of the servo system and the gimbal pickoff device are held within 10 sec of arc in the design of the system. Finally, error attributable to alignment and optical errors, scanner drift and electronics drift is expected to be held within 12 sec, the company said.

Design of the tracker places the center of gravity at the intersection of the gimbal axes. Translation force inputs therefore do not tend to rotate the system.

Test conditions for the system include a 30g shock during a period of 12 milliseconds, sinusoidal vibration of 5g from five to 400 cps, and 7.5g from 400 to 2,000 cps, random vibration at 3/100g² per cps from 15 to 2,000 cps, and 11.3g accelerations along any axis for 4.5 min.



SCHEMATIC DIAGRAM of optics-scanner system in Kollsman star trackers for OAO shows use of vibrating-reed scanners to modulate light signal from telescope (left). Block diagram of star detection electronic system for star trackers shows layout of supporting avionics (right).

Environment Chamber, Sensor Pass Tests

By William S. Reed

Los Angeles—Space chamber—in which the biomedical effects on a human subject existing in one-half atmosphere (18,000 ft.) for 48 hr. were proved to be non-deleterious—was successfully checked out during a recent test conducted by AiResearch Division of Garrett Corp.

Frank K. Greene, reliability engineer-designate for the Apollo environmental system subcontracted to AiResearch by North American Aviation, entered a chamber at 4:00 p.m. recently and emerged two days later. Purpose of the company funded test was twofold:

- **Performance of the recently completed chamber built for the aeromedical laboratory of Aeronautical Systems Division was checked out and found satisfactory prior to delivery to the Air Force scheduled for this month.**
- **Checkout of an AiResearch-developed blood pressure sensor scheduled to be carried by Astronaut Lt. Col. John H. Glenn in his orbital Mercury flight scheduled for Jan. 23.**

For the purposes of the test, the chamber internal pressure was reduced to one-half atmosphere, 380 mm. Hg., while the oxygen content was kept at sea level partial pressure, 160 mm. Hg. The remainder of the gas partial pressure in the chamber was composed of nitrogen.

Thus, while Greene existed at a simulated altitude of 18,000 ft., he wore no oxygen mask because oxygen partial pressure was the same as sea level.

Other environmental factors within the chamber were kept constant by means similar to those developed by AiResearch for the Mercury capsule, some of which will be carried over into the Apollo work. Differences in the two environmental systems will be necessitated by the longer duration of the Apollo mission, the greater volume of the capsule and a three-man crew, and the fact that the Apollo environment will be mixed gas with elevated oxygen partial pressure rather than pure oxygen.



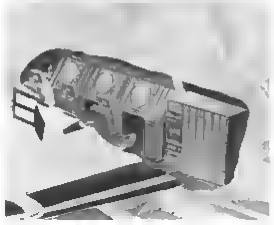
INSTRUMENTATION worn by Greene during his 48 hr. confinement under one-half atmosphere consisted of body temperature, under left arm, electrocardiogram leads on abdomen, chest and on right side of back, respiration sensor which is held in left hand but attached to microphone; pulse and blood pressure pickup, attached to left arm under arm band. Test was conducted by AiResearch Division of Garrett Corp.

ADVANCED AIR DEFENSE SYSTEMS WITH FIRST-DAY CAPABILITY

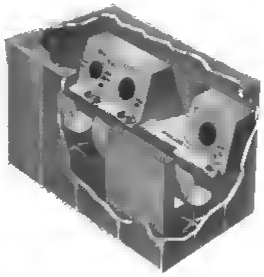
The needs of today's air defense systems pose a problem that would have seemed insoluble ten short years ago. The problem of furnishing mixed-weapons command and control, with first-day capability, in a system that is portable to any place in the world.

Here is how that problem has been solved through creative engineering utilizing a decade of industry progress in tactical data systems.

Systems already delivered by Litton to the military, or in the advanced state of development and production, include Airborne Tactical Data Systems (AN/ASQ-54, AN/ASA-27) for the U.S. Navy, the Marine Corps Tactical Data System (AN/TYQ-1, AN/TYQ-2) for the U.S. Marine Corps, and the AN/FSC-1 Retrofit Improvement System (OA-3063/FSC-1 (V)) for the U.S. Army.



The first of these, the Airborne Tactical Data Systems, provides a capability for the mission of Airborne Early Warning and Control (AEW&C) in defense of large land masses, attack carrier task groups and other naval units. Both the AN/ASQ-54, installed in a land-based AEW & C aircraft, and the AN/ASA-27, installed in a carrier-based AEW & C aircraft, furnish early warning data on enemy raids to surface elements of an air defense network and provide airborne control of interceptors.



The second of these systems, the Marine Corps Tactical Data System (MTDS), features capabilities for continuous and effective control of Combat Air Operations during an amphibious assault. Facilities are available for control of aircraft on missions such as close air support, reconnaissance, and interdiction and for air defense with mixed weapons, both ship-based and shore-based surface-to-air missiles and interceptors. An integral air traffic control system assists in initial and continuous identification of friendly aircraft.

The third, the AN/FSG-1 Retrofit Improvement System, significantly increases the counter-countermeasures capability of the AN/FSG-1 Missile Master System deployed within the Continental United

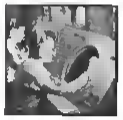


States to furnish surface-to-air missile battery coordination in the defense of large cities and industrial areas.

Through the successful design, development and manufacture of systems for air defense missions, Litton has demonstrated its capability to proceed with even further advanced data systems. Such systems are now under conception and development at Litton.

Air defense systems that not only fulfill today's defense requirements but also defy obsolescence for years to come require engineering that is versatile, inventive, aggressive, and adaptable. This is the kind of engineering Litton expects from its people. If you are qualified to perform engineering at this level, you are invited to write to H. Laur, Litton Systems, Inc., Data Systems Division, 6700 Eton Avenue, Canoga Park, California, or telephone DIamond 6-4040.

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TWIN CONSOLES monitored environmental parameters within the chamber which was occupied for 48 hr. at one-half atmosphere. Console at left monitored conditions within pressure suit subject wore while asleep. Right console monitored environment of capsule.

as is the Mercury capsule (AW July 4, 1960, p. 57).

Chamber in which Greene spent two days is not part of AiResearch's Apollo work. It was built for the Air Force and is designed to withstand 20g on a centrifuge plus internal and external pressures necessary to simulate space missions during research to be conducted at Wright-Patterson AFB, Ohio, according to Chief Engineer Dr. John L. Mason.

Key to maintaining sea level oxygen partial pressure in a one-half atmosphere environment is an electrochemical sensor which puts out a variable voltage according to the oxygen partial pressure within the chamber. Gaseous oxygen then is automatically valved into the chamber to maintain a correct oxygen partial pressure.

Measurement Instrumentation

Greene wore instrumentation attached to his person throughout the duration of his stay consisting of measurements for body temperature, respiration rate, pulse and blood pressure. Dr. James N. Waggoner, AiResearch's director of aerospace medicine, considers the method of measuring blood pressure, both systolic and diastolic of considerable interest because accurate measurements were made throughout the test without the necessity of inserting a probe in the subject's vein.

Small microphone was attached to the skin on the subject's left arm. Cardiovascular sounds picked up by the microphone were put through an electronic circuitry which filtered and modified the sounds so that direct blood pressure readings were obtainable. Value of instantaneously obtainable blood pressure readings is that when combined with pulse rate it gives an accurate picture of the subject's condition.

Pulse rate alone is not a reliable indication since a high pulse rate would indicate a patient in shock. When combined with blood pressure, a high pulse rate is acceptable because blood pressure drops correspondingly. Pulse rates of 160 per min. have been recorded on the X-15 pilots (AW Nov. 27, p. 60) and on the two astronauts. Previous method of measuring blood pressure used on chimpanzee shots was to insert a probe in the vein but this method is deemed too debilitating to be practiced on pilots during flight.

During the test Greene was on a four hour schedule: four hours work, four hours sleep and four hours recreation. The tasks which he performed were some of the daily work he does in his job as a mathematician. His routine work was carried over into the chamber to provide a comparison with the work done at his desk.

Sleeping Period

The four hour sleeping period was accomplished in a pressure suit which Greene donned before retiring. Theory is that slumbering astronauts had better wear a pressure suit in case of an emergency. Recreation was provided by FM music piped into the chamber and by reading.

Dr. Waggoner cited these effects on Greene which were immediately observable:

- Breathing was somewhat easier in the one-half atmosphere environment.
- Slight variation in systolic blood pressure was observable.
- Temperature sensitivity changed with time. When Greene first entered the chamber he was comfortable at 64F but as time went on, he requested that the temperature be raised, finally attaining a comfort level at 74F.

Whether or not the confinement had any adverse effects on Greene's work or physiology during the 48 hr. chamber stay will have to await a detailed reduction of data, Waggoner said.

British Space Spending Is $1.5 Million Yearly

London—British government is spending about $1.5 million a year on space research, mostly on Blue Streak launcher studies, the UK-1 Scout satellite which will be launched soon from Vandenberg AFB, Calif. (AW Nov. 6, cover), and Jodrell Bank radio telescope station.

Lord Hailsham, minister of science, told the House of Lords that spending level for Scout is about $288,000 a year. Delta launch vehicle is being supplied without charge by the U.S. government, although costs of Scout satellite development and construction are shared.

Lord Hailsham predicted space research grants will rise ten-fold over the next 10 years with no emphasis on man-in-space projects. Much however, depends on final agreement for the European launcher development organization, which is still under consideration by various governments. British government plans to double its present expenditure in 1962-63.

In another comment on Britain's space role, Lord Caldecote, deputy managing director of British Aircraft Corp., suggested a review of British government security clamps on its plans for peaceful uses of space.





U. S. Marine Corps has awarded Ryan Aeronautical Co., San Diego, Calif., a contract to determine possible surveillance drone applications of the firm's Flex Wing concept. Application of the drone for surveillance over enemy territory in support of tactical combat operations will be investigated. Two test vehicles have been undergoing functional and flight testing at the Marine's desert facility at Twenty Nine Palms, Calif. Drone, powered by a small piston engine, is temporarily being launched from a vehicle-mounted platform (left). At right, Cecil Craigo, Ryan Flex Wing program manager, carries the drone.



Ryan Studies Flex Wing For Surveillance Drone



Ryan recently received an Army Transportation Research Command contract to design Flex Wing towed gliders which could transport cargo for logistic needs. Flight tests and engineering studies are being conducted at San Diego plant. Note rudder on aircraft at left.

VC.10 May Eventually Land Automatically

By Herbert J. Coleman

London—Vickers VC.10 jet transport automatic control system, built into the four jet transport around proven components, is a duplex autopilot with control capability for automatic flareout and development possibilities for zero visibility automatic landings.

Importance of this electronic system to the future of the transport is demonstrated at the Weybridge production facility by construction of a full-scale control ring now in final stages of completion.

Key to the system is the Bendix PB 20D autopilot, a slightly modified autopilot that has flown for thousands of hours in British Overseas Airways Corp. Boeing 707s and is being built in Great Britain under license by Elliott Bros., Ltd., designers of the automatic landing system.

Potential Advantages

Eventually the complete automatic landing system may be linked with the automatic flareout capability to give the airplane these advantages:

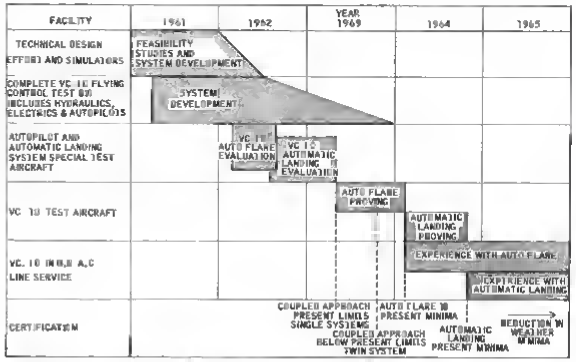
- **Reliability** during the critical landing phase, where Air Registration Board calculates accidents producing fatalities will occur at a rate of about .65 fatality in 1 million landings. The board is aiming at reducing the rate to one fatality in 10,100 million landings.
- **Lowering of weather minimums** to 200-ft. ceilings and, in theory at least, allow takeoffs and landings in zero visibility.
- **Enable airline operations managers** to offload fuel on the long haul runs such as London-New York, since complete automatic landing would obviate the need for alternate airports. This phase, however, remains theoretical because of unforeseen contingencies such as aircraft stalled on a runway, and necessity for reliable ground radar to direct traffic in zero conditions.
- **Guarantee to the operator** of design claims, such as landing and takeoff rolls and clearance over obstacles, since in effect, the actual handling of the airplane is programmed by the system.
- **Full fail-safe concept**, because the automatic landing system is duplicated and changeover from one side to the other in case of trouble, is automatic and instantaneous.

But there are problems, some of which have still defied solution. Major one—and to date there have been 17 concepts explored—is a go, no-go indication for the pilot when he reaches 200 ft. Promising solution is infrared presentation of the runway on a situation panel.

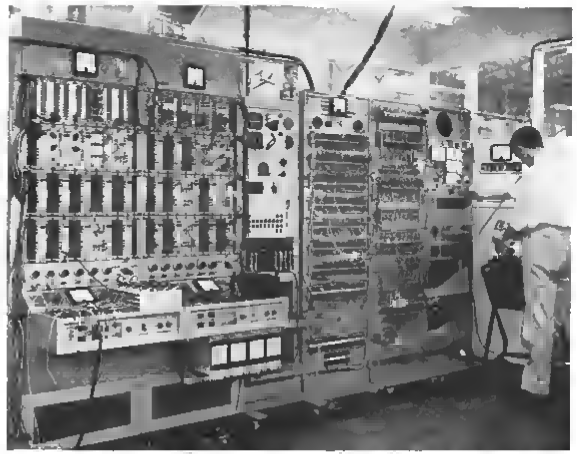
Another problem area is calibration of instrument landing systems (ILS) around the world, an item one for the VC.10 since the airplane is designed to be utilized on all of BOAC's long haul routes.

Speaking from a pilot's standpoint, Jasper Jarvis, VC.10 project pilot, admits that pilot resistance to a completely automatic system is to be expected initially, but that training and on-line experience will counteract this over a period of time.

Obviously, Jarvis says, automatic landing in effect takes away some of the pilot's command judgment and "no one yet, pilots or otherwise, has come up with a definitive explanation of exactly how to land an airplane." And the



TIME SCALE for major steps in development and certification of Vickers VC.10 automatic landing system is broken down in this chart.



LEFT CABINET of automatic flight control test rig contains an analog computer to simulate flight behavior, at center is a portion of the pilot's instrument panel, and at right is the autopilot unit.

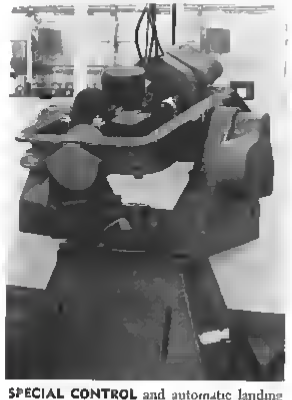
pilot's cut off button still gives him complete command, plus the ability to override the system any time he wishes through sheer control force

What the automatic landing philosophy does for the pilot—and the operations men—is rationalize the airplane's design specifications, Jarvis emphasized, to produce the performance for which it was intended and, at the same time, reducing the incidence of human error

On Vickers' other new jet transport the BAC 111, the Autoland system remains a future consideration The airplane will, of course, have an autopilot but basic design will allow an automatic landing retrofit easily if the design to equip it is made Reason for allowing the retrofit capability goes back to an unhappy experience with the Vickers Valiant V-bomber, which was built without an autopilot on the theory that in case of nuclear war, it was a one mission airplane Later, the Valiant was retrofitted with the autopilot but problems were enormous because basic design had not envisaged this possibility

Trident's System

Automatic landing is an important design feature of the system in another British transport the new de Havilland Trident This system, based on the Blind Landing Experimental Unit (BLEU) automatic flareout method is triplexed for full fail-safety Weight penalty beyond the duplicate system has been accepted because of the British European Airways European route system Airports along the medium range routes may not have maintenance facilities immediately available for such complex equipment, and failure of one of the three systems would not ground the airplane away from its home maintenance facilities



SPECIAL CONTROL and automatic landing test rig built by Vickers Armstrongs (Aircraft) Ltd. for VC10 at Weybridge, England, includes this gyro sensing unit Device has six gyros and is mounted on a test table supported by gimbals, table can be tilted or can be rotated to any angle simulating flight movement

The Trident system is designed by Smiths Ltd, and initially the airplane will have the duplicate system, with triple-redundant system installed at a later date As with the VC 10 the system has been developed in parallel with the airplane

In a discussion of the economic advantages of automatic landing Vickers' G W Webber noted that aside from the reduction of minimums aircraft fitted with the device are at a competitive advantage in winning passengers from other non-automatic landing equipped airlines plus avoiding disruption of schedules

Scatter ratio of the predicted touchdown point is sharply reduced Webber pointed out, considering the variables impressed on the pilot by wind shear, center of gravity variation and glide slope angles He predicts a "drastic reduction" in undershoot and overshoot accidents, along with a hefty cutback in hard landings

Increased automation on landings will Webber feels, be a vital necessity in development of the supersonic transport

Development Program

Development of the VC 10 system is in two main stages the first allowing fully automatic control in pitch alone using the BLEU automatic flare concept, and the second automatic control in all three axes for fully automatic landing Webber said this approach was followed for these reasons

- **All equipment needed** to ensure automatic flareout can be carried aboard the airplane Thus introduction of the system is independent of the necessity for installation of new ground facilities Operational experience can be readily gained although use of the system below the present 300 ft minimum will be dependent on reliability of the ground ILS facility
- **Final selection** of the azimuth guidance system has not yet been made Webber said use of ground leader cable installations would give satisfactory results but he has doubts whether international acceptance of the cable installation could be gained Improvements to ILS localizers will overcome some of the drawbacks of present installations and there are indications these hopes can be realized soon Some development work has been carried out on microwave replacements for the leader cables having the advantage of constant amplitude sensitivity without the difficulties of ground installation past airport boundaries
- **Introduction and acceptance** of complete automatic landing to pilots and operations, in Webber's opinion, 'is not going to be easy pilots and airworthiness authorities are going to need a lot of convincing that we have evolved a safe and reliable system" Considering this aspect what Jarvis referred to as "resistance," the step by step approach is considered a good first stage

Autoflare system is installed in the VC 10 calls for use of a Standard Telephone & Cables STR-42 radio altimeter now under development The design includes a self monitoring feature to produce an alarm signal if any elements fail, and installation will be duplicated

Other equipment includes

- **Marconi AD 260 glide slope** receivers, also including self monitoring features
- **Monitored automatic flare computer** under development by Elliott Bros to generate necessary control laws The unit probably will consist of an open-loop term to elevator, plus a smaller amplitude closed loop term for accuracy
- **Automatic changeover unit,** of which the highest possible reliability is required since this unit connects the two halves of the total system The device uses duplicated glass sealed relay contacts actuated magnetically A Perspex glass plate covers the black box to allow the pilots a visual checkout of movement of the contact points
- **Automatic throttle control** for determination of airspeed on the final approach and during flareout System has duplicated monitored air data sensing with each of the main air data sensors and comparison monitor air data sensors being supplied from independent sources Duplicated signal channels feed two motors to drive the four throttle levers in unions, through individual magnetic clutches

Extension of the automatic flare system to complete automatic landing would call for

- **Self monitored** azimuth guidance receivers and a compass azimuth monitor to ensure integrity of compass signals used to initiate kickoff of drift just before touchdown
- **Azimuth landing computer** and azimuth changeover unit

In future applications, design trends may point to control even after automatic touchdown, when the pilot normally would take over braking and taxi directional control The system envisioned would include a director facility for manual guidance along the runway with director information given on a situation display panel in the cockpit Automatic coupling to nosewheel steering and automatic braking and/or thrust reversal could be another follow on application according to Webber



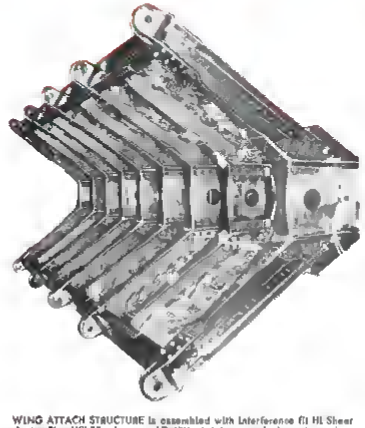
LEFT
NOSE CONE radius joints are fastened with HS67 pins, type 431 stainless steel, heat treated to 125,000 psi minimum shear The HS60M collars are R monel



RIGHT
WING SPARS front and rear, have cap strips attached to web sections with HS92 pins, A286 alloy heat treated to 95,000 psi minimum shear HS90M collars are used



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Advanced Systems	G	F, G, H, O, M, N, R, X
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	Q	P, S, T, K

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Company
Position
Years of experience (from)
(to) Salary
Assigned Duties

GENERAL ELECTRIC

PERSONAL DETAILS

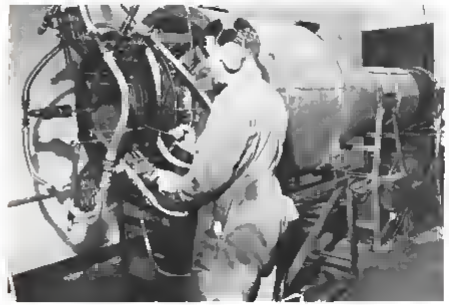
Name
Home Address
City State
Telephone
U.S. Citizen Yes ☐ No ☐

Education Undergraduate

College Year of Graduation
Degree
Graduate

College Year of Graduation
Degree
Position Objective (primary job preference level of responsibility, salary expectations)

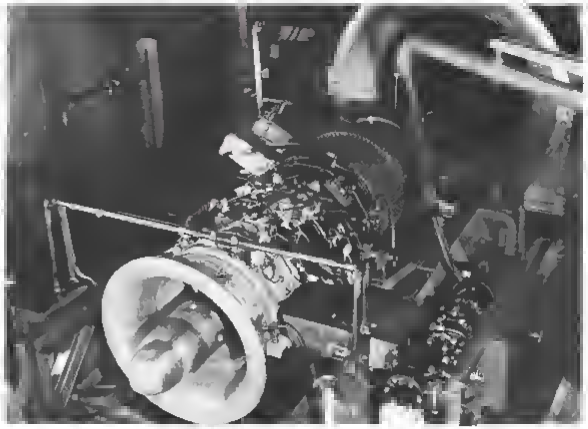






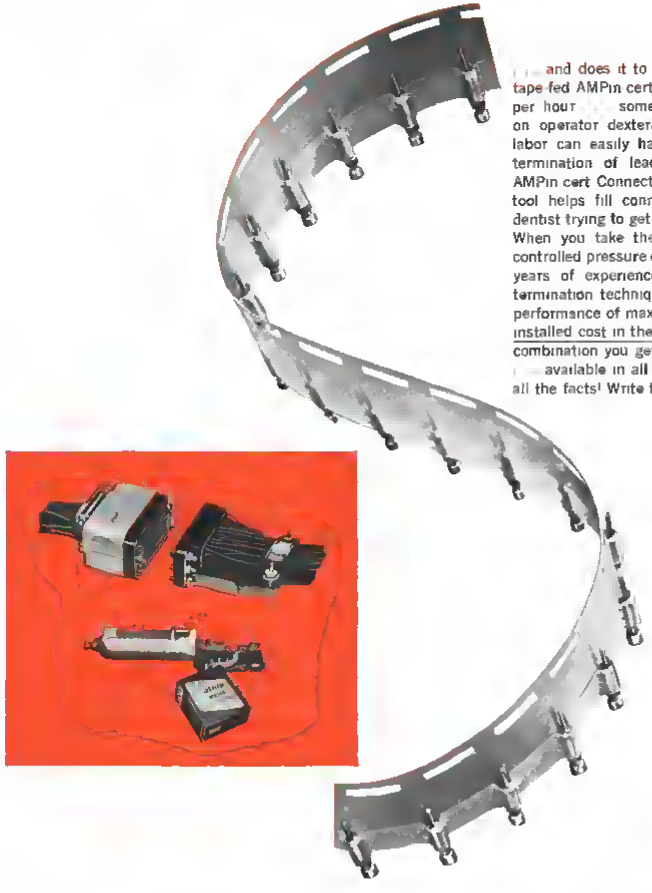
Two new Bristol Siddeley powerplants for forthcoming jet transports are at the static-test stage of development. The Bristol Siddeley Viper 20 turbojet (right) which will power the de Havilland DH 125 executive transport and the prototypes of the Douglas-Piaggio PD-808 executive jet, has begun test stand runs at the company's Patchway plant, England. Bristol Siddeley BS.75 turbofan engine (below) is scheduled to begin static tests this month. Above, the thrust reverser for the BS.75 is shown undergoing development tests on the tailpipe of an Olympus engine

BS.75 Nears Test Phase; Viper 20 Makes Static Runs



Second BS.75 turbofan engine is expected to be completed next month. Powerplant, which has been chosen for the BAC 107 jet transport, the future of which is still uncertain since work is currently concentrated on the BAC 111, develops 7,550 lb thrust. Engine is a front fan, two-shaft powerplant with bypass ratio of 1.75:1 and specific fuel consumption of 0.508 lb/hr/lb. Another view of the Viper 20 is at right. Engine is a follow-on to the Viper 11, with an additional compressor stage to increase static thrust to 3,000 lb., 500 lb more than the Viper 11. Specific fuel consumption has been improved from 1.07 lb./hr./lb. to 0.985 lb./hr./lb.

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Space Vacuum Raises Avionic Problems

By Philip J. Klass

Washington—Hard vacuum of deep space causes new modes of failure in some types of avionic components and raises a number of new reliability problems for avionic designers, Eric L. Brueschke told the Eighth National Symposium on Reliability and Quality Control.

The problem is aggravated by the fact that it is extremely difficult and costly to build facilities for simulating the vacuum encountered more than several hundred miles above the earth.

Radiation from the Van Allen belts and other cosmic sources also poses a hostile environment for many types of avionic components, but there is more data available on these effects, Brueschke indicated.

The tests described by Brueschke were conducted at Hughes Aircraft Co. at pressures down to approximately 10^{-9} millimeters of mercury, equivalent to an altitude of about 250 mi. Results of the Hughes tests disclosed the following:

• **Molded composition resistors,** ½ watt, 5% tolerance, experienced a decrease in resistance of up to 6.5% during a 2,690-hr exposure at room temperature at a simulated altitude of about 200 mi. Molded carbon resistors of this type are known to be humidity-sensitive. The change in resistance experienced under vacuum is similar to that encountered when such resistors are baked at atmospheric pressure to drive out moisture, Brueschke said, suggesting a similar action was taking place. The percentage change in resistance was greater for units of high resistance.

• **Three molded metal-film resistors,** each 1.25 megohms, 1% tolerance, ½ watt, were placed in a 250-mi. simulated vacuum. After 190 hr., one of the units has increased in resistance by more than 500% to 8.2 megohms, while the other two had undergone little change. An autopsy on the faulty unit disclosed several occluded gas pockets near the metal film surface. Slow diffusion of such gas pockets to the surface could have caused strains which fractured the film element.

• **Etched circuit boards,** XXXP type, ⅛ in. copper-clad laminate, were exposed to a 150-mi. vacuum for 4,000 hr. For 100 hr. the board was exposed at a temperature of 85C to 100C, and to mild ultraviolet radiation for 250 hr. Measurement of the board's insulation resistance during exposure showed that it never fell below 500,000 megohms, indicating no adverse effects. Examination after the board was removed from the chamber showed low warpage and excellent bond strength between the copper and the board. Insulation resistance following exposure was 1 million megohms at 500 v.d.c.

• **Vinyl tubing** subjected to simulated altitude of 150 mi. for 100 hr., with temperature raised to 45C for 2 hr., was found to be covered with an oily substance which analysis showed to be the plasticizer.

In some cases, the vacuum environment appears to be beneficial. For example, Hughes found that Teflon can withstand 170 times more radiation in a vacuum than in the earth's atmosphere before crumbling.

Other components, such as capacitors, may not require presently used containers. Hughes tested an uncased Mylar capacitor, which weighed 20% less than a conventional encased unit, filled with silicone, for 2,500 hr. at a simulated altitude of 150 mi. while operated at



MIDARM Measures Gyroscope Accuracy

Drift rates in inertial guidance system gyroscopes are being measured to an accuracy of 0.0002 deg. per hr. at Sperry Gyroscope's Marine Division with a wide-angle, electro-optical high resolution autocollimating device called MIDARM II (Micro Dynamic Angle and Rate Monitoring System). Instrument can externally measure incremental table displacements to within 0.05 sec. of arc over a wide range. MIDARM, developed and manufactured by Razdow Laboratories, Inc., Newark, N.J., is A in photo, gyroscope is B. Razdow recently received a $41,000 contract to install a MIDARM system at Dayton Air Force Depot's Heath inertial guidance calibration facility, Newark, Ohio. This installation will check readouts of gyro test tables which will calibrate drift of gyros used in Minuteman, Hound Dog, Titan, Atlas and Skybolt guidance systems.

Vacuum Tests Needed

Washington—All-out program to test a wide variety of avionic components under deep space vacuum conditions, with government sponsorship and coordination is badly needed now, according to a number of reliability specialists attending the Eighth National Symposium on Reliability and Quality Control.

"Unless the National Aeronautics and Space Administration and/or the Defense Department move quickly, the reliability of our space probes will fall far short of present goals," one conference attendee said. "The cost of building hard vacuum facilities for such tests is beyond the means of most component manufacturers and many equipment suppliers. Government financial support and coordination to prevent needless waste of limited facilities through uncoordinated duplication of tests is called for," this observer contends.

rated (100 v d c) voltage. Approximately 1,000 hr. of the test were conducted at a temperature of 125C. During the test the insulation resistance never fell below 155 megohms, well within specifications. The initial value of capacitance of 1.046 mfd. had changed only slightly to 1.036 mfd. after 2,500 hr., and the dissipation factor had shifted from 0.005 to 0.004.

Brueschke said a small amount of water vapor had collected on the sample. He attributed this to further polymerization of the Mylar dielectric.

Brueschke warned that any component containing materials which have a high vapor pressure are potential trouble-sources in space, and that the problem is aggravated if the component material operates at elevated temperatures.

Hughes currently is conducting reliability tests on 2,500 semiconductor diodes, with half of the sample operated at 10^{-8} mm Hg and the remainder at atmospheric pressure. The two samples are further divided into separate groups that will be operated at different temperatures over a wide temperature range. From these tests, company hopes to develop derating curves to assist designers in applying the diodes for space applications.

Mechanical Effects

Hughes also ran tests to determine the effect of vacuum on mechanical and electro-mechanical components, a field in which others also are making investigations. Although seizure (cold weld) between two metal surfaces did not occur in all tests, Brueschke pointed out that Hughes vacuum chambers did not permit simulation of the 10^{-15} mm Hg pressures found at higher altitudes. Additionally, the test chambers restricted the mean free path of molecules more than in space, restraining the amount of metal surface cleansing action which could be achieved in the chamber.

Without this constraint in the true space environment and with the higher temperatures due to solar radiation, surfaces will become cleaner which will increase the likelihood of seizure.

Possible Solutions

Several possible solutions suggested by Brueschke for the seizure problem for metal parts, such as bearings, include:

- **Maintain pressure** at metal surface above 10^{-8} mm Hg and surface temperature below 100C.
- **Use low vapor pressure greases** which evaporate slowly enough to provide lubrication during the expected life of the space vehicle. Use of a lubricant reservoir and small bearing clearances also are helpful.
- **Use non-metal bearings**, such as Teflon. This poses some design problems in certain applications because the bearing deforms under light load.
- **Use solid film lubricants** which can perform over a wide temperature range, such as molybdenum sulfide.

Vacuum-Temperature Effects

Hughes conducted limited tests to determine how the absence of convection cooling in a vacuum affected resistor operating temperature using a ½-watt molded composition resistor. The tests indicate that a resistor operated at a 200 mi. altitude must be derated by 30% to 60% to maintain its surface temperature at the atmosphere value, depending upon the diameter of the resistor leads which serve to conduct away heat. The 30% figure applies to a resistor with leads of 0.032 in. dia., the 60% figure to a resistor with lead diameter of 0.010 in.

FILTER CENTER

▶ **Air Force's Aeronautical System's Division** is seeking qualified sources to develop optical maser equipment and techniques applicable to machining, welding or cutting metals. Optical maser beams precisely focused have so high an energy density that they can melt or vaporize metals. It is this characteristic which will be explored in a forthcoming ASD program and which is the basis of speculation about possible use of the optical maser as a radiation weapon.

▶ **TAC Gets First "Talking Bird"**—First of two air transportable communication command posts, called "talking bird," intended for use by Tactical Air Command, has been delivered to 839th Air Division at Langley AFB. The 15,000-lb. package of single sideband and other telecommunications equipment, designed to be transported in a C-130, will enable Composite Air Strike Force commanders operating at remote theaters to maintain instant contact with their headquarters. Four additional talking bird packages are planned, two for USAF Europe and two for Pacific Air Forces.

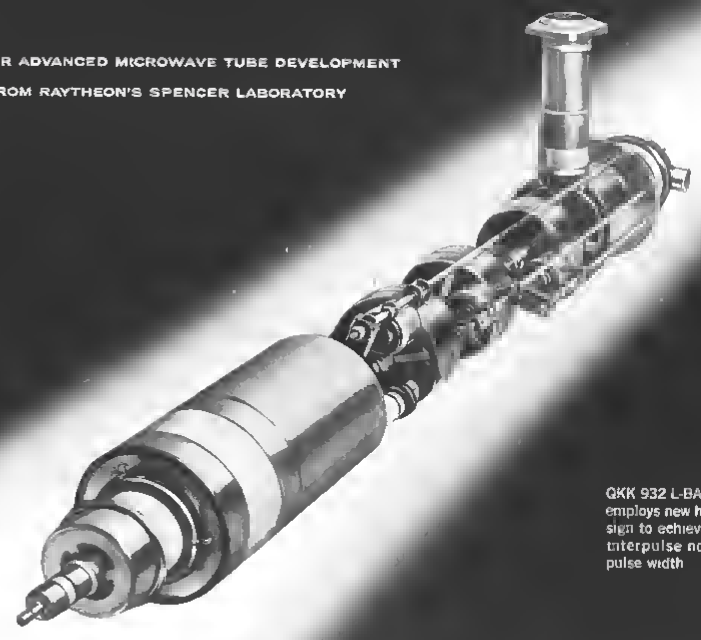
▶ **Glass Laser Material Developed**—Use of a glass instead of a crystal or gas in an optical maser (laser) has been announced by American Optical Co. Use of glass eliminates difficulty in forming special laser shapes, for example, a long glass fiber can be used for a traveling wave laser or optical transmission line. Large surface area of glass fiber in relation to volume is expected to simplify cooling of continuous wave solid state laser. Material developed by American Optical is a rare earth glass active ion is trivalent neodymium. Output wavelength is in infrared region at approximately 1.06 microns.

▶ **TFX Radioactive Fuel Gage**—Radiation fuel gage which uses low level radioactive gamma sources such as Cobalt 60 or Cesium 137, is being proposed as an alternate fuel gage to principal bidders in the current Air Force TFX tactical fighter competition. The gage being proposed by Atomics International Division of North American employs a single detector located on the opposite side of the fuel tank from the radioactive sources. The detector is struck by gamma photons not scattered or absorbed by the fuel. Attenuation of the gammas is a direct function of the tank fuel level.

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include the following:

- **Radio Corp. of America**, $5 million from Army for continued effort on Advanced Research Projects Agency Project DAMP—Downrange Anti-missile Measurement Program—a study of ballistic missile in-flight radiation characteristics.
- **Philco Corp.**, Lansdale, Pa., $474,733 in two contracts for procurement of 1N78B and 1N26B high temperature diodes from Dayton Air Force Depot.
- **Datex Corp.**, Monrovia, Calif., $304,887 from Army Signal Supply Agency for an automatic meteorological data acquisition system to be installed at the White Sands Missile Range.
- **Collins Radio Co.**, Cedar Rapids, Iowa, $1.8-million Navy contract for AN/ARC-51 airborne transceivers.

ANOTHER ADVANCED MICROWAVE TUBE DEVELOPMENT
FROM RAYTHEON'S SPENCER LABORATORY



QKK 932 L-BAND KLYSTRON employs new hollow beam design to achieve long life, low interpulse noise, and wide pulse width

SOMETHING NEW IN KLYSTRONS

Raytheon's QKK 932, first to use magnetron injection gun and modulating anode, offers the advantages of:

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- Modulating Anode mu of 3.
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- Long pulse operation (up to 1000μs or longer).

The QKK 932 is a 4-cavity, solenoid focused klystron with a peak power output of 35 kw. The tube is mechanically tunable from 1250-1350 Mc, and has 40 db minimum gain with a minimum efficiency of 35%.

A series of hollow beam injection gun klystrons, from 8 watts CW to 2 Mw peak, are in advanced stages of development. Write today to Raytheon Company, Microwave & Power Tube Division, Waltham 54, Massachusetts.

QKK 932—GENERAL CHARACTERISTICS

Peak Power Output	35 kw min.
Frequency (tunable)	1250-1350 Mc.
Gain	40 db min.
Efficiency	35% min
Cathode Voltage	25 kVdc
Modulating Anode Voltage	+7.85 kv (peak), —2 kV bias
Input Connection	Type N
Output Connection	1⅝" coax.

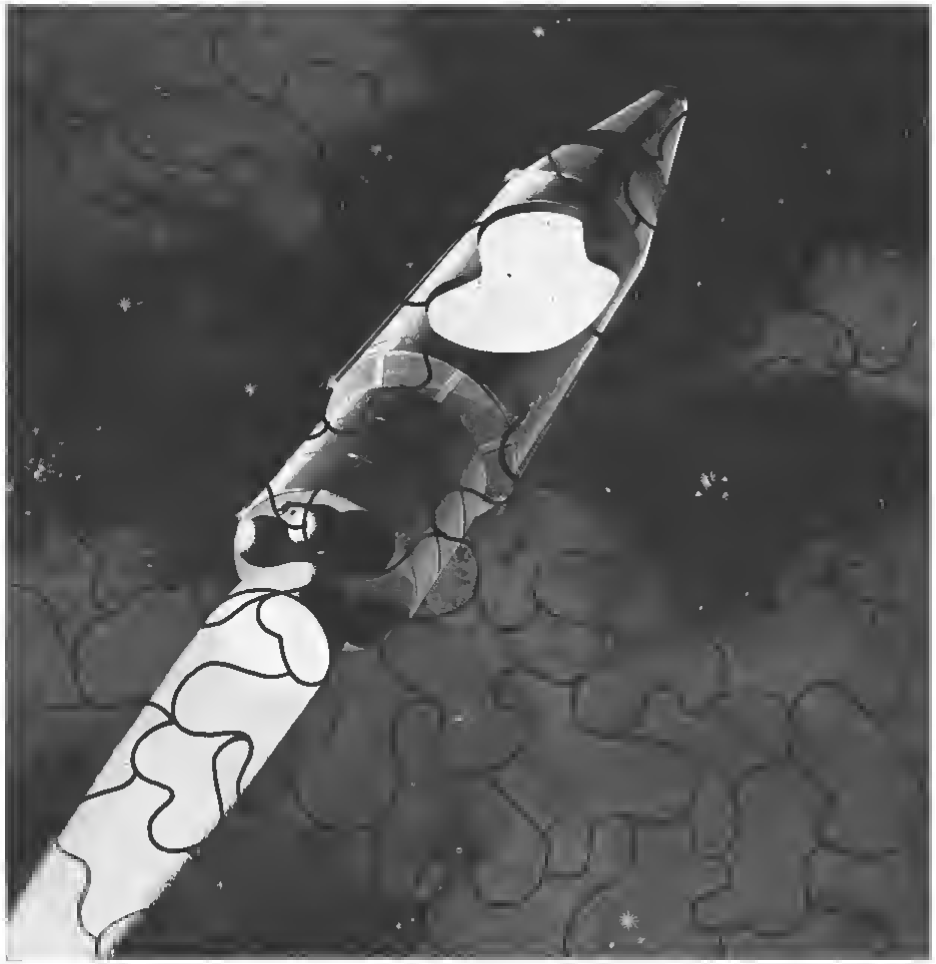
RAYTHEON COMPANY

MICROWAVE AND POWER TUBE DIVISION

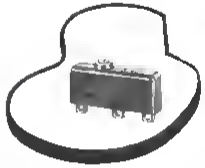
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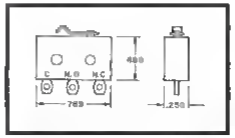
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***Temperature Range**—All joints of the "HM" Series are welded or high-temperature brazed to assure reliability and long life in temperature ranges from —300°F to +250°F.*

***Hermetic Seal**—The seal at the actuator diaphragm and around the mounting holes is by metal-to-metal fusion. The terminals seal is glass-to-metal. This provides a true hermetic seal. The switching element chamber is evacuated, filled with inert gas, sealed, then checked by a mass spectrometer.*

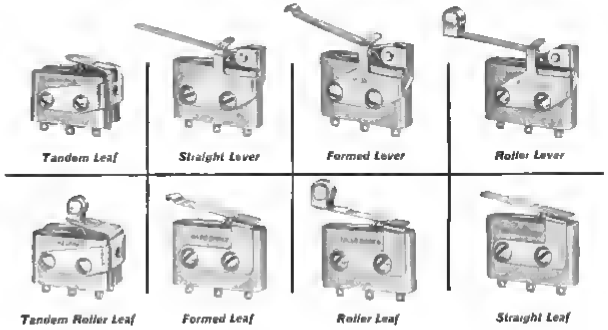
***Corrosion Resistant**—Stainless steel construction of all exposed parts meets corrosion resistant requirements of MIL-S-6743.*

***Circuit**—Contact arrangement is single-pole double throw.*

***Rating**—Electrical rating is 3 amps inductive and 5 amps resistive at 28 vdc. Especially suitable for low-energy or "dry" circuits and for long shelf-life requirements. Minimum mechanical life is 25,000 operations.*

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BEFORE
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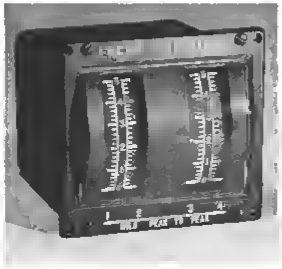
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Semi-automatic high-vacuum deposition system which can fabricate up to 500 custom-made thin film microcircuits (film resistors and capacitors on glass substrates) in single two-hour vacuum cycle is being offered to systems manufacturers on a license/lease basis by Lear, Inc. Company proposes to train customer's technicians, maintain equipment and provide guidance in return for licensing fee plus royalty. Here, microcircuit is removed from system which deposits one of three materials through five masks on substrates placed in 20 holders.



• **Quad indicator,** Type MDE-4, a dust-sealed four-element meter for ground and airborne use contains four self-shielded coaxial meter movements with sensitivities as low as 100 microamperes. Meters can be used to measure d-c millamperes, amperes, millivolts, and volts, and a-c volts. Front panel measures 2.75 x 3 in., over-all depth of the four-element meter measures 3.25 in. Manufacturer: Minneapolis-Honeywell Regulator Co., Precision Meter Division, Grenier Field, Manchester, N.H.

• **Static relay,** Model DD-5, is a general purpose DPST relay composed entirely of solid state components. Like electromechanical relays, Model DD-5 is characterized by electrical isolation of contacts from each other and from the actuation circuit, and snap action for on and off switching. In addition, the actuating circuit is non-inductive, and contact bounce, chatter, and arcing are eliminated by the use of solid state components. Maximum d-c contact voltage is 28 volts with resistive load, 25 volts with inductive load; maximum contact current is 50 milliamperes. The relay is epoxy encapsulated. Dimensions are 1.31 in. diameter, 1.63 in. height. Manufacturer: Kidde Electronics Laboratories, Clifton, N.J.

• **Meter linearity tester,** Model 113, was designed for fast evaluation of linearity of d-c moving coil meters. The tester checks 10 points on each meter with an error of no more than ±0.2%; meters may have full scale sensitivities from 50 microamperes to 1 milliampere. A reversing switch permits tests of zero-center meters. Manufacturer: IB Instruments, Box 2460, Cleveland 12, Ohio.



• **Miniature high-mu triode,** Type 581, for pulse modulator service, can deliver 13 kw pulse power. Maximum anode voltage is 20 kv, peak plate current is 1.2 amps, and grid bias is 300 volts. Tube length is 2.75 in., diameter is 1.13 in. Manufacturer: United Electronics Co., subsidiary of Ling-Temco-Vought, Inc., 42 Spring St., Newark.

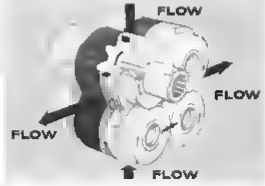
• **Pyrotechnic free gyro,** Model 34110, using electrically ignited solid propellant and simultaneous electrical uncaging, provides attitude data for short-range missiles or initial flight of longer range missiles. Run-up period is 100 milliseconds, maximum drift rate is 1 degree/minute. Over-all dimensions are 2½ x 3⅜ x 3¼ in. Manufacturer: Giannini Controls Corp., 1600 S. Mountain View Ave., Duarte, Calif.

• **Differential amplifier,** Type 2N2060, consists of two matched silicon planar transistors in a six-lead TO5 package. Maximum noise figure is 8 db, h_{FE} is matched to within 10% at 0.1 and 1.0 milliampere collector current, and maximum allowed base-emitter voltage differential is 5 millivolts. Maximum allowable base voltage differential change is 10 microvolts °C between −55 and +125C at 0.1 milliampere collector current. Manufacturer: Fairchild Semiconductor, 545 Whisman Rd., Mountain View, Calif.

• **Potentiometer pick-off,** Model 10111, converts linear or non-linear motion into linear or non-linear voltages, as desired, with high resolution. Resistances between 500 and 100,000 ohms per inch, sensitivity as high as 300 volts per inch, and linearity with 0.05% per inch are available. The non-metallic thin film resistance element is non-inductive and has a guaranteed life of 10 million cycles. Manufacturer: Computer Instruments Corp., 90 Madison Ave., Hempstead, Long Island, N.Y.

• **Passivated silicon diode dice,** Types MSC-1 and MSC-2, can meet or exceed MIL-S-19500B without additional sealing, according to manufacturer. MSC-1 is designed for high-speed computer applications, has 2 nanosecond recovery time, 75 volts peak inverse voltage, reverse leakage of 0.1 microampere at 50 volts (25C), and forward current of 10 milliamperes at 1 volt. MSC-2 is a general purpose type, with 300 volts peak inverse voltage, and reverse leakage of 0.01 microamperes at 300 volts. Individual dice are 0.20 in. square, 0.007 in. thick. Cathode and anode are gold plated; connections may be thermo-compression bonded, plated, or soldered. Manufacturer: Microsemiconductor Corp., 11250 Playa Court, Culver City, Calif.

• **Thermoelectric spot cooler,** Model 094447, cools five diodes mounted in evacuated enclosure and insulated electrically from thermoelectric circuit and mounting base by a high thermal conductivity ceramic. Cooler can maintain a 20-mw load at −58F, or a 200-mw load at −27.4F, with heat sink at +80.6F (in both cases, heat sink must be capable of dissipating 4 watts). Device requires 3 amp at 1.2 volts d-c. Manufacturer: Pesco Products Division, Borg-Warner Corp., 24700 North Miles Blvd., Bedford, Ohio.



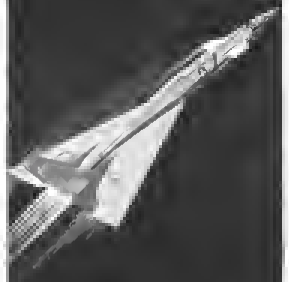
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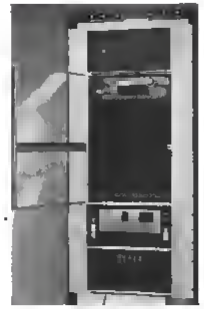
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Graphite Resistance Heater Permits Lengthy Runs of Hypersonic Tunnel

Graphite resistance heater, developed by the Princeton University Department of Aeronautical Engineering, is the key element in continuous operation of a new hypersonic test tunnel.

The tunnel uses nitrogen as the working fluid, and has been run at temperatures above 5,000F at stagnation pressures between 1,000 and 1,500 psi. Continuous operation is possible with this tunnel up to Mach 20, for periods up to five minutes of test time. Limitation is because of the amount of compressed air available for the ejector system.

Current development of the heater, sponsored by USAF's Office of Aerospace Research Mechanics Branch, is aimed at obtaining a system to operate at 10,000 psi and 6,000F.

The available working range of temperatures and pressures is believed to be the highest achieved anywhere according to Prof. Seymour M. Bogdonoff, head of the Gas Dynamics Laboratory at Princeton. He points out that the system has been running at these sustained high temperatures and pressures without any contamination.

This is attributable to several factors, but primarily to the choice of nitrogen as the working fluid and graphite.

Nitrogen can be obtained in a very pure form, with an absolute minimum of impurities. Cleaning and handling techniques, applied to the components of the system, eliminate another possible source of stream contamination. Outgassing of the system before operation is a pre-requisite.

Trace impurities can't be entirely eliminated, so the graphite chosen must have a high resistance to oxidation. The Princeton group specified a coating of pyrolytic graphite over the contact faces of the heater elements. This thin, impervious layer eliminated a major problem: chemical reactions resulting from the impurities, which eventually eroded holes through the walls of the heater and ended its useful life.

The Princeton project is the result of continuous development of high Mach number test techniques by the group, starting back in 1950 with a helium tunnel that ran at Mach numbers above 20. But test results in helium, a monatomic gas, do not apply directly to air, which is diatomic.

Special heating systems have been developed which operate air tunnels up to Mach numbers approximating 14; above this level, there is difficulty in finding heater materials that will take the hot oxidizing atmosphere caused by the required test gas stagnation temperatures. Dr. A. G. Hammitt, now with Space Technology Laboratories, thought that the oxidation problem could best be solved by avoiding it. In 1957, he proposed that a tunnel use a gas which is similar to air and also inert to a particular heater material. Nitrogen and graphite seemed like a natural combination, which would produce problems only at temperatures high enough for the two to react chemically. This occurs above 5,400F at atmospheric pressure and at higher temperatures at pressures above atmospheric, which is when the nitrogen begins to dissociate.

Hammitt initiated the work, did the initial experimentation, and continued to be associated with the project until June, 1960.

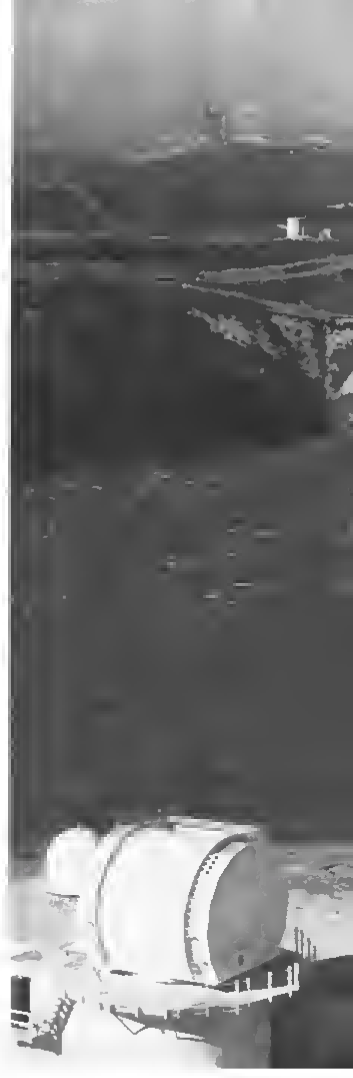
Princeton is careful to emphasize that the work up to now has been to develop the heater; only preliminary flow investigations have been made in the wind-tunnel nozzle. They also credit groups at Langley Research Center of the National Aeronautics and Space Administration, as well as at Lockheed Aircraft Corp., with significant work on graphite heaters.

But Princeton feels its main contribution is that the heater has been used to run a test pilot tunnel continuously at sustained high temperature and pressure without any contamination of the air stream.

Blimp Airlift for S-4

Goodyear Aircraft and the National Aeronautics and Space Administration are discussing modification of a Navy-Goodyear ZPG-3W airship to ferry the Douglas S-4 rocket vehicle stage from the El Segundo plant to Cape Canaveral. Modification would involve stripping the blimp's avionics gear and installing a landing gear which would straddle the stage.

First S-4 stages produced probably will be shipped by sea through the Panama Canal, since the blimp modification cannot be completed in time to air lift them.



Gersis Radome

Gersis, a General Electric developed system consisting of a high-precision automatic radar tracking system working with Doppler devices, will be used to ensure safety of inhabited islands near Atlas impact points in forthcoming Nike Zeus/Atlas target trials (AW Jan. 8, p. 33). Radome at bottom, installed on hill at Pt. Arguello, Calif., overlooking missile gantries and Pacific Ocean houses Gersis equipment.

WEATHER ENGINEERING

... a new field with new opportunities for

Electronic Engineers, Mathematicians, Physicists

A new field of technology — weather engineering — is today creating unusual growth opportunities for electronic engineers and others with associated skills. Our organization, for instance, is assisting both the Federal Aviation Agency and the United States Air Force in the development of systems for the collection of weather data, high speed transmission of the data, computer processing and display.

Project teams are engaged in all phases of system engineering from analysis of user requirements to environmental testing of systems and sub-systems. Advanced electronic equipment is under development including a communication system many times faster than any of its type currently in use.

To men of ability, we offer the opportunity to work with a fast growing group that is still small enough so that ability is quickly recognized. Then, too, there are the advantages of pleasant New England living and the stability inherent in a major corporation.

Write immediately if you are interested in the challenge of designing, developing and testing unique new equipment and systems — the personal satisfaction of being associated with a project with many humanitarian aspects — the opportunity to build a satisfying career in a new field with outstanding growth potential.

ELECTRONIC ENGINEERS to analyze requirements for the collection, transmission and display of weather information, evaluate present equipment, conceive and design advanced digital and video equipment to meet requirements utilizing modern techniques such as magnetic tape, drum and core storage, sonic relay lines, optical storage, advanced solid state logic, digital to voice converters, etc., accept full responsibility for planning and executing all phases of the assigned work.

SENIOR ENGINEERS to execute and coordinate advanced technical assignments in development/testing of electronic equipment and weather station layout and operation. Must be capable of organizing all phases of electronic development projects preparing feasibility studies of station layout, operation, maintenance and evaluating engineering techniques and processes.

SYSTEM ENGINEERS to evaluate concepts for system operation and integrate these concepts with specified system goals. Must originate and perform design studies in system, sub system and major component areas involving general and specific purpose digital computers, communication devices, data acquisition and display equipment, establish functional and engineering requirements for the design and procurement of major system components; direct and technically supervise subcontractor efforts in major component development.

OPERATIONS ANALYSTS to evaluate the requirements of users of civil and military weather systems and analyze various feasible solutions to determine optimum system configurations; devise objective techniques for solving complex system design problems and apply these techniques. The operations analyst will obtain a thorough knowledge of the operations of civilian and military agencies and become familiar with the future plans of these groups. This knowledge will be incorporated in studies of the weather system.

SYSTEM PROGRAMMERS to design and develop computer control routines for large-scale real time systems, design and develop high-volume data handling programs, design input/output programs for use with high-speed computers and special-ized electronic equipment; modify developmental scientific computer programs for application to real time systems.

Write Mr. E. O. Curlew or call Hartford, Connecticut, JAckson 8-4811, Ext. 6426 Collect

Weather System Center — UNITED AIRCRAFT CORPORATION — EAST HARTFORD, CONNECTICUT

All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

Defense Lists Top 500 R&D Contractors

Defense Department's list of 500 military prime contractors that received awards of $10,000 or more in Fiscal 1961 for experimental, developmental, test and research work is headed by General Dynamics Corp., whose R&D contracts totaled $577,034,000.

The list comprises two sections, the first listing 390 business firms and the second listing 110 educational institutions, government agencies and other non-profit institutions. Of the 390 business firms, 126 are small firms.

In addition to the 500 contractors shown in this report, 1,282 business and non-profit organizations received prime contract awards of $10,000 or more for experimental, developmental, test and research work in Fiscal 1961, for a total of 1,782 contractors. Of this figure, 570 were large firms, 796 were small businesses and 416 were government, non-profit or foreign organizations.

Total net value of these R&D type awards of $10,000 or more increased from $5,532 million for Fiscal 1960 to $6,025 million for Fiscal 1961. The 500 top contractors accounted for $5,951 million or 98.8% of the total for Fiscal 1961, compared with 98.4% of the Fiscal 1960 total.

In Fiscal 1961, 88% of all R&D type contracts of $10,000 or more awarded to U.S. business firms was for work on missile, aircraft, ship and electronic programs.

BUSINESS FIRMS

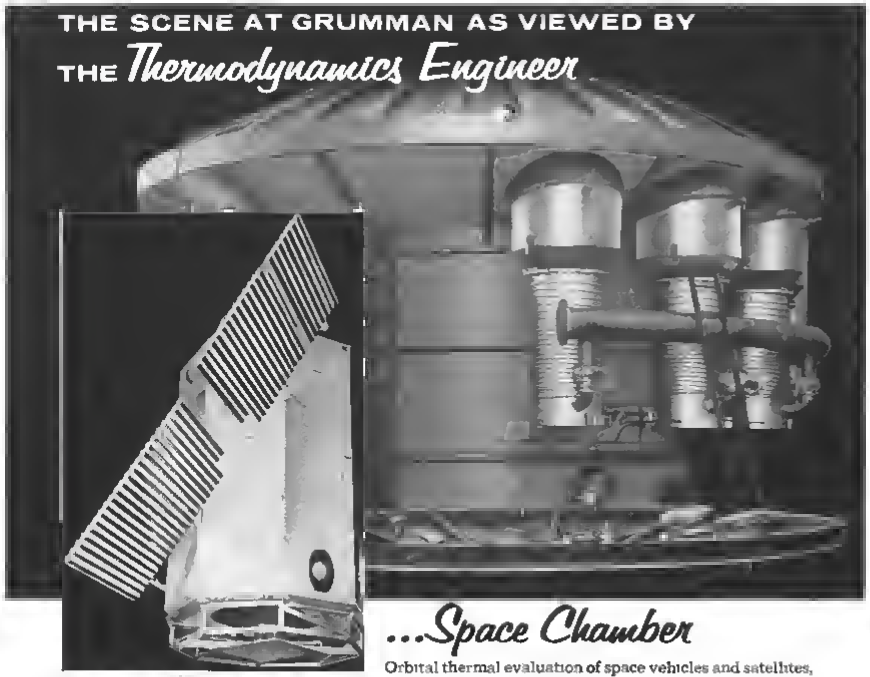
Rank	Name of Company	Thousands of Dollars
1	General Dynamics Corp.	$577 034
2	Lockheed Aircraft Corp.	576 341
3	North American Aviation	415 405
4	General Electric	334 625
5	Martin Co.	328 743
6	Boeing Co.	290 824
7	Western Electric	279 836
8	Aerojet-General	203 217
9	Thiokol Chemical Corp.	151 206
10	Westinghouse Electric	149 771
11	Sperry Rand Corp.	147 379
12	Douglas Aircraft	142 978
13	United Aircraft	105 421
14	Pan American World Airways	98 100
15	ITT	96 910
16	General Motors Corp.	95 985
17	Radio Corp. of America	88 200
18	AVCO Corp.	82 724
19	Hercules Powder Co.	72 695
20	Bendix Corp.	71 760
21	Hughes Aircraft Co.	58 572
22	Philco Corp.	57 648
23	Space Technology Laboratories	57 366
24	Raytheon Co.	55 798
25	IBM	38 609
26	American Bosch Arma	37,279
27	Ford Motor Co.	35 735
28	Sylvania	30 337
29	Northrop Corp.	27 871
30	Aro, Inc.	26 339
31	Goodyear Aircraft Corp.	25 27[illegible]
32	Minneapolis-Honeywell	24 822
33	Fairchild Stratos Corp.	23 296
34	Vitro Corp. of America	22 323
35	American Machine & Foundry	20 069
36	Thompson Ramo Wooldridge	17 962
37	General Tire & Rubber	15 139
38	Alpha Corp.	14 874
39	Cutler-Hammer, Inc.	13 879
40	Kaman Aircraft Corp.	13 789
41	Republic Aviation Corp.	r3 815
42	Eastman Kodak Co.	r3 045
43	McDonnell Aircraft Corp.	11 952
44	Marquardt Corp.	11 461
45	Bell Aerospace Corp.	11 266
46	Motorola, Inc.	10 519
47	Texas Instruments, Inc.	10 [illegible]
48	Burroughs Corp.	10 173
49	ACF Industries, Inc.	8 833
50	Hazeltine Corp.	8 675
51	Curtiss-Wright Corp.	8 613
52	Sanders Associates, Inc.	8 [illegible] 81
53	Aircraft Armaments, Inc.	8 453
54	Hoffman Electronics Corp.	8 322
55	Fairchild Camera & Instrument	8 274
56	General Precision, Inc.	8 212
57	Control Data Corp.	7 816
58	Land-Air, Inc.	7 302
59	Chance Vought Corp.	7 172
60	Isotechnical Corp.	7 036
61	Litton Systems, Inc.	6 428
62	Turbinex Electric Corp.	6 [illegible]78
63	Collins Radio Co.	6 163
64	Gilfillan Brothers, Inc.	6 [illegible]011
65	FMC Corp.	5[illegible]76
66	Varian Associates	5 964
67	Melpar, Inc.	5 832
68	Aeronutronic Associates	5 426
69	Atlantic Research Corp.	4 928
70	United States Undersea Cable Corp.	4 862
71	Hallicrafters Co.	r 761
72	Edo Corp.	r 706
73	Litton Industries, Inc.	r 683
74	Solar Aircraft Co.	r 408
75	Continental Aviation & Engineering Corp.	4,786
76	Callery Chemical Co.	4 163
77	Cubic Corp.	4 136
78	Little (Arthur D.) Inc.	3 923
79	General Mills, Inc.	3 812
80	Minnesota Mining & Manufacturing Corp.	3 58[illegible]
81	Huyck Corp.	3 536
82	Northern Ordnance, Inc.	3 489
83	Union Carbide Corp.	3 384
84	Federal Electric Co.	3 167
85	Cook Electric Co.	3 135
86	Rohm and Haas Co.	2 934
87	Garrett Corp.	2 893
88	Maxson Electronics Corp.	2 806
89	Telecomputing Corp.	2 [illegible]71
90	Ryan Aeronautical Co.	2 [illegible]52
91	Magnavox Co.	2 [illegible]40
92	National Co., Inc.	2 481
93	Chrysler Corp.	2,416
94	Helock Instrument Corp.	2 371
95	National Cash Register Co.	2 287
96	Technicol Operations, Inc.	2 232
97	Electro Optical Systems, Inc.	2 182
98	Esso Research & Engineering	2 [illegible]75
99	Dow Chemical Co.	2 [illegible]00
100	United Electrodynamics, Inc.	2 106
101	Radiation, Inc.	2 083
102	H.R.B. Singer, Inc.	2 0[illegible]6
103	Clevite Corp.	1 948
104	Monsanto Chemical Co.	1 918
105	Parsons (Ralph M.) Co.	r 118
106	Dynatronics, Inc.	1 870
107	Perkin-Elmer Corp.	r 849
108	Beech Aircraft Corp.	1 709
109	Lyon, Inc.	r 780
110	Radio Condenser Co.	r 771
111	Lear, Inc.	1 741
112	Ampex Corp.	1 709
113	T.R.G., Inc.	1 667
114	Walkins-Johnson Co.	1 65[illegible]



380-hp. Engine to Power Comanche

Lycoming IO-720 eight-cylinder 380-hp. engine is expected to be the powerplant of an advanced Piper Comanche light aircraft now in the flight test phase. Use of this new aircraft powerplant will enable the Comanche to carry fuel sufficient for 2,100-mi. range at an economical cruising speed.

THE SCENE AT GRUMMAN AS VIEWED BY THE *Thermodynamics Engineer*



...Space Chamber

Orbital thermal evaluation of space vehicles and satellites, such as the Orbiting Astronomical Observatory for NASA, will be made in Grumman's large space vacuum chamber. This will be part of the test development program which also includes spectrophotometer experiments, absorptivity-emissivity evaluations and structural temperature gradient determinations with sections of the vehicle, using a small vacuum chamber with solar simulator. Grumman heat transfer engineers combine analytical work with the necessary experimental verification from preliminary proposal and design through product development. With Grumman contracts well diversified in the space, aircraft and marine fields, heat transfer engineers are working in:

- Aerodynamic Heating
- Ablation
- Structural Temperature Analysis
- Electronic Cooling
- Temperature Control Systems
- Air Conditioning
- Engine Compartment Cooling
- Anti-Icing Systems

Here is the environment and challenge for men seeking comprehensive development in the field of thermodynamics-heat transfer. Specific opportunities exist for:

Senior Thermodynamicists—Advanced degree with a minimum of 5 years experience performing difficult heat transfer analysis. Work includes aerodynamic and re-entry heating, structural temperature determination and heat transfer phenomena in propulsion systems.

Aerothermodynamicists—Challenging work involving hypersonic flow analyses for aerodynamic heating. Should be familiar with one or more of the following areas: external pressure distributions, real gas effects, rarefied gas dynamics, viscous flow phenomena, non equilibrium fluid mechanics.

Heat Transfer Engineers. Challenging work on both high density air cooled electronic equipment, and electronic equipment which must function in a vacuum. Must be able to perform detailed analyses of equipment cooling requirements and initiate necessary thermal tests.

Temperature Control Engineers—Engineers with training to handle space vehicle temperature control system analysis. Should have background in radiative heat exchange and thermal coatings as applied to passive and active temperature control systems.

To arrange an immediate interview, send your resume to Mr. W. Brown, Manager Engineering Employment, Dept. GR-25
(U. S. citizenship required)

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All qualified applicants considered regardless of race, creed, color or national origin.



Piper Cherokee Tested With Floats

Piper Cherokee is being flight tested in seaplane configuration at Piper's Vero Beach research facility. Company is expected to announce certification plans in several weeks if flight work continues to prove satisfactory and dealer response is adequate. Floats were made and installed by the Edo Corp. of College Point, N.Y. Cherokee is powered by a 160 hp. Lycoming O-320-B2B engine. Floats are attached to three mounting points which correspond to mounting locations of original fixed landing gear.

115	Operations Research, Inc.	1,020	182	Development Engineering Corp.	1,007	208	Hyson Manufacturing Co.	606
116	Simplex Wire and Cable Co.	1,010	183	Analytic Services, Inc.	1,000	210	Geophysics Corp. of America	605
117	Piasecki Aircraft Corp.	1,575	183	Amelco Astrophysics	997	211	Baird-Atomic, Inc.	604
118	DuPont (E. I.) De Nemours & Co.	1,510	184	Amelco Astrophysics	997	212	Flightex Fabrics, Inc.	602
119	S F D Laboratories, Inc.	1,523	185	Intersonic Electronics Corp.	991	213	Booz Allen Applied Research Inc.	504
120	Allied Research Associates Inc.	1,522	186	American Cyanamid Co.	981	214	Narmco Industries, Inc.	504
121	Laboratory for Electronics	1,431	187	American Air Filter Co.	985	215	Plain National Watch Co.	490
122	Aero Geo Astro Corp.	1,428	188	Commercial Engineering Co.	982	216	Norris-Thermador Corp.	488
123	Olin-Mathieson Chemical Corp.	1,416	189	Barnes Engineering Co.	968	217	High Temperature Materials Inc.	480
124	Sundstrand Corp.	1,394	190	Bell Rexroth & Newman	932	218	Ball Brothers Research Corp.	480
125	Hayes Corp.	1,390	191	Arinc Research Corp.	923	219	Systems Technology, Inc.	481
126	General Telephone & Electronics Labs., Inc.	1,360	192	American Science & Engineering, Inc.	921	220	Sangamo Electric Co.	480
127	Dunlap Associates, Inc.	1,316	193	Electronic Communications, Inc.	901	221	Universal Match Corp.	480
128	Microwave Associates, Inc.	1,320	194	Planning Research Corp.	891	222	Lake Shore, Inc.	480
129	Grand Central Rocket Co.	1,299	195	Ethyl Corp.	880	223	Wyandotte Chemicals Corp.	475
130	CEIR, Inc.	1,291	196	Polarad Electronics Corp.	876	224	Zenith Radio Corp.	471
131	Coleman Engineering Co., Inc.	1,288	197	Goodrich (B. F.) Co.	873	225	Amalin Co.	460
132	Pickard and Burns, Inc.	1,230	198	United Technology Corp.	850	226	Admiral Corp.	447
133	Edgerton, Germeshausen & Grier, Inc.	1,246	199	Firestone Tire & Rubber Co.	848	227	Epsco, Inc.	445
134	Brown (Dayton T.) Inc.	1,243	200	Lockheed Electronics Co.	838	228	Digital Equipment Corp.	434
135	United Research, Inc.	1,242	201	General Atronics Corp.	810	229	Dresser Industries, Inc.	434
136	Hughes Tool Co.	1,235	202	United States Steel Corp.	799	230	National Scientific Laboratories, Inc.	430
137	Budd Co.	1,230	203	Telephonics Corp.	789	231	Associated Aero Science Laboratories, Inc.	418
138	Itek Corp.	1,220	204	Weh Chang Corp.	779	232	Instrument Corp. of Florida	416
139	Lenkurt Electric Co., Inc.	1,220	205	Melabs, Inc.	759	233	White Motor Co.	414
140	Harvey Aluminum, Inc.	1,204	206	Aerojet General Nucleonics	756	234	Washington Technological Associates, Inc.	543
141	Consolidated Systems Corp.	1,198	207	Santa Barbara Research Center	743	235	Power Generators, Inc.	419
142	F R D Electronics, Inc.	1,111	208	Loral Electronics Corp.	728	236	Chesapeake Instruments Corp.	410
143	Space Electronics Corp.	1,175	209	Stoddart Aircraft Radio Co.	711	237	National Research Corp.	408
144	American Electronics Laboratories, Inc.	1,163	210	Dewey (G. C.) Corp.	707	238	Kaiser Industries Corp.	404
145	Emerson, Inc.	1,162	211	Le Tourneau (R. G.) Inc.	704	239	Nuclear Corp. of America	398
146	Ewen Knight Corp.	1,160	212	Pacific Semiconductors, Inc.	701	240	Iansky and Polley, Inc.	379
147	Wyle Laboratories	1,120	213	Manufacturing Laboratories, Inc.	681	241	Mason Products, Inc.	375
148	Consolidated Electrodynamics Corp.	1,127	214	Caterpillar Tractor Co.	665	242	Kollsman Instrument Corp.	512
149	A F N, Inc.	1,121	215	Rucker Co.	664	243	American-Marietta Co.	504
150	American Optical Co.	1,117	216	Sprague, Inc.	661	244	United States Industries, Inc.	495
151	Page Communications Engineers, Inc.	1,082	217	Packard-Bell Electronics Corp.	662	245	Electronics Systems, Inc.	495
152	Grumman Aircraft Engineering Corp.	1,081	218	Goodrich High Voltage Astronautics, Inc.	652	246	Beckman Instruments, Inc.	494
153	Holmes and Narver, Inc.	1,065	219	Aro Products, Inc.	642	247	Conoga Corp.	492
154	Emerson Electric	1,052	220	Cleveland Pneumatic Industries, Inc.	640	248	Weidrex Corp.	490
155	Chamberlain Corp.	1,040	221	Bliss (E. W.) Co.	640	249	Cohu Electronics, Inc.	487
156	General Applied Science Laboratories	1,048	222	Audiger, Inc.	674	250	Hiller Aircraft Corp.	470
157	Pacific Car & Foundry Co.	1,041	223	General Electronics Laboratories	672	251	Gulton Industries, Inc.	415
158	Textron, Inc.	1,040	224	Manson Laboratories, Inc.	629	252	Systems Research Laboratories, Inc.	415
159	Borg-Warner Corp.	1,010	225	American Potash & Chemical Corp.	618	253	Travenol, Inc.	474
160	Whirlpool Corp.	1,022	226	Shirley Corp.	607	254	Comstock & Wescott, Inc.	466
161	Reeves Instrument Corp.	1,025	228			255	Electro-Mechanical Research, Inc.	451
						256	Pneumodynamics Corp.	454
						257	Sparton Corp.	451
						258	Allied Chemical Corp.	410



Today, the design and development of space systems, vehicles and weapon systems is achieving an even greater degree of importance than before. Expenditures are increasing. The pace is being stepped up.

Hughes Aerospace Divisions are expanding with each of these progressions. Important projects such as SURVEYOR, SYNCOM, ION ENGINE, ARPAT, BAMBI and advanced POLARIS guidance are now underway. Others will begin soon. This expansion is producing new, challenging assignments that never existed before. The opportunity is for you. You can be a part of, and benefit from, Hughes further expansion into the space picture.

If you hold a degree from an accredited university in Mechanical Engineering, Electronic Engineering or Physics, are a U. S. citizen and have experience or interests related to Aerospace Vehicles or Weapon Systems, you can qualify. A few of the openings include:

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Concerns airborne computers and other controls related areas for missiles and space vehicles satellites, radar tracking, control circuitry, controls systems, control techniques, transistorized equalization networks and control servomechanisms

circuit designers
Involves analysis and synthesis of systems for telemetering and command circuits for space vehicles, high efficiency power supplies for airborne and space electronic systems, space command, space television, guidance and control systems, and many others

systems analysts
To consider such basic problems as the requirements of manned space flight, automatic target recognition requirements for unmanned satellites or high speed strike reconnaissance systems, IR systems requirements for ballistic missile defense

infrared specialists
To perform systems analysis and preliminary design in infrared activities involving satellite detection and identification, air to air missiles, AICBM, infrared range measurement, air to air detection search sets, optical systems, detection cryogenics and others



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258	[illegible]	[illegible]
260	Cl[illegible] Aircraft	367
261	Continental Motors Manufacturing	370
262	Daniel M[illegible] & Machine	111
263	Lockheed Aircraft Service Inc	414
264	Beechcraft Research & Development Inc	[illegible]
265	Catalyst Research Corp	109
266	Thompson (John T.) & Co	109
267	Stauffer Aerojet Co	42
268	Carborundum Co	42
269	All American Engineering Co	109
270	Mine Safety Appliance Co	110
271	Gleonial Controls Corp	110
272	Carrier Corp	418
273	Bulova Watch Co Inc	41
274	A R T Electronics Inc	411
275	Columbia Broadcasting System Inc	111
276	Microwave Electronics Corp	411
277	Chicago Aerial Industries Inc	409
278	Eagle-Picher Co	368
279	Sundt (M M) Construction Co	401
280	California Computer Products, Inc	462
281	Continental Motors Corp	460
282	Trak Electronics Co Inc	305
283	Barkley and Dexter Laboratories Inc	384
284	Automatic Corp	361
285	Pennsalt Chemicals Corp	383
286	Oxford Corp	392
287	Houston Fearless Corp	360
288	Vickers Inc	350
289	Farrand Optical Co	387
290	Watson Automotive Equipment Co	385
291	Kellett Aircraft Corp	381
292	Underwood Corp	370
293	Western Union Telegraph Co	373
294	Servo Corp of America	374
295	Technology Inc	372
296	Champion Company	371
297	Gilmore Industries Inc	371
298	Spacelabs Inc	370
299	Plasmadyne Corp	368
300	United States Rubber Co	366
301	N T W Corp	360
302	Air Reduction Co Inc	358
303	National Engineering & Science Co	357
304	Universal-Cyclops Steel Corp	353
305	Specialty Electronics Development Corp	60
306	Kellogg (M W) Co	346
307	Horbridge House Inc	344
308	Dikewood Corp	342
309	Babcock Electronics Corp	341
310	Research Inc	341
311	Arrowhead Manufacturing Corp	341
312	Blaw Knox Co	338
313	Haushel Corp	336
314	Aeroprojects Inc	335
315	Barnes & Reinecke Inc	333
316	Hamilton Watch Co	331
317	General Aniline & Film Corp	330
318	Airtronics Inc	330
319	Hydronautics Inc	329
320	Electronic Associates Inc	328
321	Pilgrim Research Inc	327
322	Gabriel Co	327
323	Ampex Military Products Co	326
324	Sielma, Inc	320
325	Creative Arts Studio Inc	320
326	General Analysis Corp	320
327	Bloom Berman Corp	320
328	Raven Industries Inc	320
329	Hanson Brothers	319
330	Sanborn Co	317
331	De Laval Steam Turbine Co	317
332	Inomet Corp	314
333	Alloyd Corp	314
334	Adcole Corp	314
335	Hoadline Technical Development Center Inc	110
336	Hewlett Packard Co	110
337	Dynalectron Research Corp	107
338	Migo Electronic Corp	106
339	Webcor Inc	103
340	Beaushoft & Fuchs Inc	103
341	Electro Nuclear Systems Corp	103
342	Servomechanisms Inc	102
343	Metal Hydrides Inc	100
344	United States Borax & Chemical Corp	300
345	General Instrument Corp	297

PROBLEMATICAL RECREATIONS 102



A canoe is floating in a swimming pool. Which will raise the level of the water in the pool higher, dropping a penny into the pool or into the canoe? Or does it make any difference?

– Contributed

Our projects involving airborne and air-transportable data systems require engineers with specialized experience. If you've gotten familiar with circuit design, digital components and techniques, please let our Mr. Harry Laur know. You'll find him at our Data Systems Division in Canoga Park, California.

ANSWER TO LAST WEEK'S PROBLEM. The problem is one of finding three right-angled triangles of different dimensions but of the same area, viz. 840 sq. ft. There are just three such triangles and their dimensions are (1) 42, 40, 58; (2) 70, 24, 74 and (3) 112, 15, 113. Number 1 has the smallest perimeter and is, therefore, the one Perkins chose.

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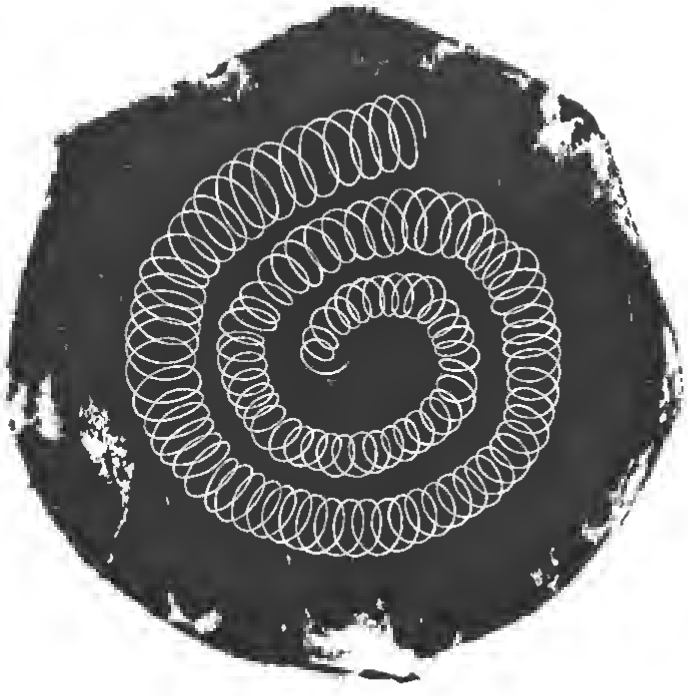
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Said Svante Arrhenius: *"The change of the logarithm of a chemical reaction rate constant with respect to temperature, is inversely proportional to the square of the absolute temperature."*

The aerospace industry is searching constantly for strong, light-weight, heat resistant materials. Finely-spun glass fiber, bonded with a plastic binder is beginning to exhibit superior properties. Until recently the glass fiber has been far more heat-resistant than any binder.

Scientists at Lockheed Missiles & Space Company, however, have developed a compatible binder. This now makes it necessary for the glass-producing industry to evolve a glass to match its superior heat-resistance.

Comparable successes are being achieved in dozens of disciplines in which Lockheed is engaged. As Systems Manager for the DISCOVERER, MIDAS and other satellites, and the POLARIS FBM, Lockheed probes all areas of aerospace endeavor.

Lockheed Missiles & Space Company is located on the beautiful San Francisco Peninsula, in Sunnyvale and Palo Alto, California. Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. M-30A, 599 Mathilda Avenue, Sunnyvale, California. An Equal Opportunity Employer.

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Morane-Saulnier MS 885 Super Rallye in Production

Six Morane-Saulnier MS 885 Super Rallye light planes are shown on the ramp at the company's factory. More than 500 orders have been received for the aircraft, including more than 350 export orders. Aircraft is powered with a 145 hp. Continental O-320 A engine. Versions with 165 and 200 hp. engines are under development.

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GOVERNMENT AGENCIES AND NON-PROFIT INSTITUTIONS

Rank	Agency or Institution	Thousands of Dollars
1	Massachusetts Institute of Technology	$80,13
2	Johns Hopkins University	14,40
3	Aerospace Corp	22,111
4	Mitre Corp	1,844
5	Columbia University	1,671
6	Rand Corp	13,808
7	Michigan University of	12,920
8	Stanford Research Institute	12,151
9	California, University of	11,971
10	Aerospace Research Foundation	10,923
11	Stanford University	8,571
12	Cornell Aeronautical Laboratories, Inc	8,008
13	Illinois University of	7,452
14	Cornell University	6,496
15	Woods Hole Oceanographic Institute	6,317
16	Pennsylvania State University	4,077
17	Chicago University of	4,174
18	System Development Corp	3,686
19	United States Department of Commerce	3,980
20	Ohio State University	3,882
21	Battelle Memorial Institute	3,748
22	New York University	3,583
23	Washington University of	3,492
24	Texas, University of	3,265
25	George Washington University	3,051
26	Princeton University	2,589
27	Harvard University	2,768
28	Defense Analysis Institute for	2,471
29	Minnesota, University of	2,452
30	Southwest Research Institute	2,331
31	Brooklyn Polytechnic Institute of	2,226
32	California Institute of Technology	2,142
33	Franklin Institute of Pennsylvania	2,057
34	National Academy of Sciences	2,038
35	Pennsylvania University of	1,809
36	Denver, University of	1,821
37	Illinois Institute of Technology	1,739
38	Dayton, University of	1,784
39	Northwestern University	1,837
40	Midwest Research Institute	1,379
41	Southern California, University of	1,366
42	New Mexico State University of Agriculture, Engineering & Science	1,324
43	Stevens Institute of Technology	1,321
44	Syracuse University	1,260
45	U. S. National Aeronautics & Space Administration	1,173
46	Colorado, University of	1,149
47	Maryland, University of	1,129
48	Alaska, University of	1,092
49	U. S. Atomic Energy Commission	1,062
50	Perdue Research Foundation	969
51	Pittsburgh, University of	948
52	Brown University	920
53	Canadian Canning Co.	921
54	Duke University	876
55	Miami, University of	827
56	U. S. Federal Aviation Agency	798
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63	Georgia Technical Research Institute	632
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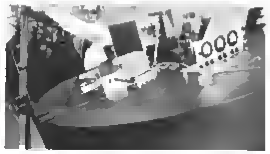
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HONEYWELL SYSTEM 'SHIFTS GEARS' FOR SPACE PILOT—An autopilot that thinks for itself typifies Honeywell's recent developments work. Called an Adaptive Flight Control System it senses the changing responses of a craft in its environment—and automatically adapts the ship's controls throughout the enormous dynamic range. The Honeywell system—first to blend aerodynamic and reaction controls in a single system—will permit the X-15 to reach the limits of its design capabilities.



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WHO'S WHERE

(Continued from page 23)

Changes

Cdr. Fred W. Frank, Jr. (USN, ret.) joined the Aerospace Industries Assn. on Jan. 1, and has been named to staff the AIA's National Aerospace Standards Committee and the Engineering Contract Requirements Committee.

Dr. Lewis D. Kaplan, chief of the newly created Planetary Studies Section, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, Calif.

Matthew W. Urlaub, project manager for the advanced Saturn booster, Saturn Systems Office, Marshall Space Flight Center, Huntsville, Ala.

Col. Henry H. Etchel, deputy commander of boost vehicles, Space Systems Division, Air Force Systems Command.

Martin W. Sullivan, Jr., manager of quality control for Radio Corp. of America at the Atlantic Missile Range.

Laurence K. Loftin, Jr., assistant director, National Aeronautics and Space Administration's Langley Research Center, succeeding John Stack (AW Nov. 27, p. 17). Also, Dr. John E. Duberg, technical assistant to the center's associate director.

Theodore F. Raess, engineering manager-Polaris project, Westinghouse, Sunnyvale (Calif.) Division.

Aerojet-General Corp., Azusa, Calif., has appointed W. A. Fiala as special Washington (D.C.) representative for the AEC-NASA Nerva nuclear rocket engine program. George P. Unas will succeed Fiala as manager of Washington (D.C.) Operations for the company's Azusa plant.

James S. LaRue, program manager for the Motorola/Autonetics Minuteman Reliability Program, Motorola's Semiconductor Products Division, Phoenix, Ariz., succeeding George R. Tallent, now manager of transistor production.

Jan C. Mueller, director, Engineering Science Division, Ann Arbor, Mich., of American Metal Products Co., and Dr. John G. Lewis, assistant director.

V. P. Gibney, sales manager, Propulsion Controls, Bendix Products Aerospace Division of The Bendix Corp., South Bend, Ind., and R. E. Miller, assistant sales manager.

Russell C. Cole, director of research for the newly organized Marine Corps Section of Massachusetts Institute of Technology's Operations Evaluation Group, Washington, D.C.

James L. Maddox, chief engineer, Philco Corp.'s Computer Division, Willow Grove, Pa.

Stanley K. Hellman, chief nuclear engineer, Vitro Engineering Co., New York.

Raymond Chaney, manager of military requirements, Hiller Aircraft Corp., Palo Alto.

Don Sweet, senior group engineer, Electronic Engineering Company of California, Santa Ana, Calif.

Harry G. Earl, assistant to the president, B-H Hadley, Inc., Pomona, Calif.

Dr. Robert S. Voris, manager of the newly created High Energy Research Division, Hercules Powder Co.'s Research Center, Wilmington, Del.



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ENGINEERS—(BS or MS) with 4-5 years experience in gas dynamics and nozzle mechanics design. Design and analysis of nozzles for solid propellant rocket engines, conceptual design of advanced nozzles, including regeneration and sublimation cooling.

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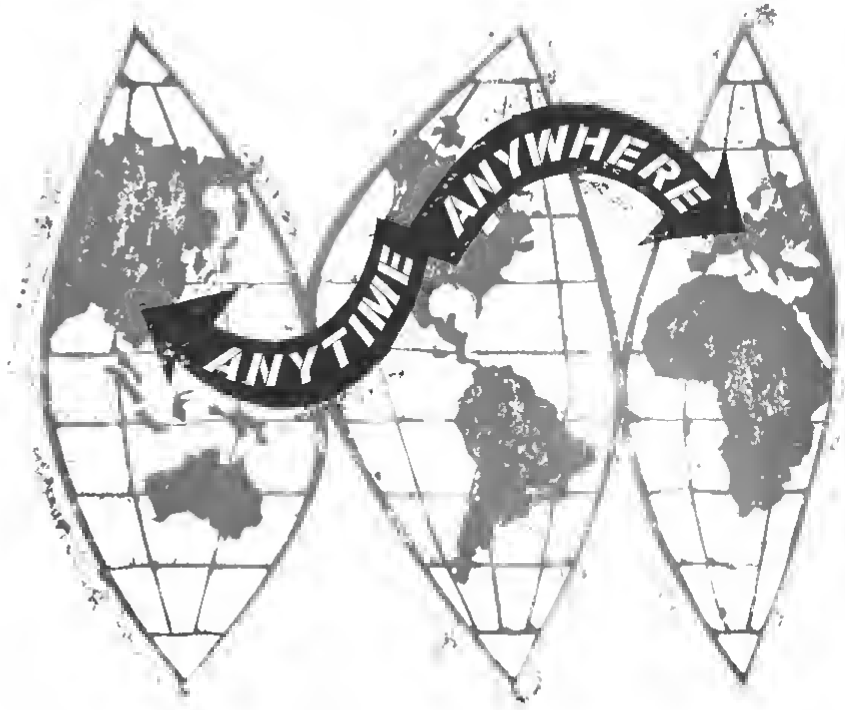
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This section will be the more useful to all as a result of this consideration.

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LETTERS

Convention Recruiting

We read with a great deal of interest your article in the Dec 25 issue (p 51) of AVIATION WEEK on the improvement of technical conventions. We feel your conclusions make sense and deserve much thought by the parties involved. And we hope your ideas are given wide dissemination within the technical community.

We ourselves are very much involved in this question of technical conventions as you will be able to see from the attached material. We have published Engineering and Technical Conventions for a number of years and it represents, to our knowledge, the only single source of inter disciplinary conference information. About three years ago at the request of the Engineers Joint Council we expanded ETC to cover a period of five years as one attempt to improve inter-society meeting coordination. Judging from comments from the societies and from industry, this has helped somewhat to avoid the overlap in meetings which you deplore in your article.

We feel your article left out one other important problem with regard to today's technical convention—the intensive recruitment activities which in many instances, tend to interfere and detract from the exchange of technical information which you so rightly call the primary objective of these meetings. In relation to this you may be interested in the report of a survey we made of over 200 organizations on the subject of convention recruiting. The consensus among these companies was that convention recruiting should be more strongly controlled. We are at present attempting to set up an inter-society meeting to deal with this suggestion (see AW Oct 23, p 99).

In the event that you speak or write further on the subject as I hope you will, perhaps you might also deal with this recruiting problem.

Once again, we want to say how pleased we are to see others speak out on this very important problem—the improvement of technical conventions.

VAN M. EVANS
Executive Vice President
Deutsch & Shea, Inc.
New York, N.Y.

Crusader Comments

Your photo coverage of the deck-level F8U ejection (AW Dec 25, pp 76, 77) was most interesting. Some of your caption writer's comments, however, have left this reader, for one, in a state of "How's that again?"

The statement that relative deck velocity dropped from 98 kt to 60 kt is reasonable enough. Most ships try for 40 kt of wind over the deck; most jets come aboard in the speed range 125-140 kt (indicated airspeed)—depending on type, gross weight (stores, fuel) and configuration. Hence the figure 96-98 kt, which is quoted as deck contact speed, IAS minus relative wind, is about right for the F8U. It stands to reason that some deceleration took place, and I expect a time-frame study of the photo sequence bears this out.

Where I start to get puzzled is that "... 6" kt due to loss of wind as the aircraft emerged off deck over water ... off the aircraft left the deck with the relative velocity with which it reached the deck edge, then that velocity was still 60 kt. If it increased due to power addition (possible, but pictures do not indicate this) that is the only way it could have increased—not due to "loss of wind."

If what your copywriter was talking about was airspeed, then he forgot to backtrack his arithmetic. Airspeed leaving the deck was relative velocity plus relative wind; in this case, not less than 100 kt. I guarantee that if the U.S. bird left the deck with 6" kt of airspeed, pitch down would have been followed by inverted contact with water. Furthermore, there would have been insufficient airspeed for the Martin-Baker Escape System to function, as shown.

As for the statement that "Pilot was traveling slowly enough to land safely without chute," I doubt if anyone (especially Mr. Krwan) could be found to bet his life on it.

In the first place, assuming wind over the water at 15 kt, that would call for an 85 kt water contact—almost certainly fatal. Secondly, if the M.B. system functions (as the pictures most graphically show), there can be no question of not having a chute (last picture shows all three chutes out of pack, personnel chute streamed). Without a chute, the pilot would still be in the seat (last picture shows seat separated)—because it is the personnel chute which pulls him out of the seat. In other words, if he hits the water before the main (personnel) chute opens, he hits it with the extra weight of the seat still tied to his back, so without a chute, even if water contact velocity were not fatal, hitting water with a hundred pounds of aluminum would really do the trick.

Suggest your copywriter case over to the Naval Aviation Safety Center at Norfolk for a briefing on the Martin-Baker ejection seat.

Alternatively, I'll send him some dope—it's part of my job. I'm an aviation safety officer.

J. M. VERDE
Norco, La.

(Reader Verde raises a valid point. The caption under the pictures was correct mathematically, but was vaguely worded and did not in every case explain what speed was being cited. To begin with, wind over water speed was 35 kt at the time of the incident and the carrier was making approximately 6 kt.

(The final landing speed of the F8U is 137-138 kt and maximum permissible over the deck speed is 105 kt due to arresting gear limitations.

(Thus a landing speed of 138 kt minus 35 kt wind speed minus 6 to 7 kt ship motion (the ship was heading to the right of the wind line due to the angled deck) gives a deck contact speed of 96 to 98 kt. Drag from the momentary engagement of the arresting wire and from the wheelless landing gear strut reduced this to approximately 60 kt relative to the deck of the carrier. As the aircraft emerged over the end of the deck, its speed relative to the surface of the ocean was then approximately 67 kt (IAS of approximately 102 kt minus—rather than "loss of"—wind speed of 35 kt). Lt. Krwan's parachute, as shown in the last picture of the sequence, is deployed but only slightly ballooned. Whether it opened completely before he contacted the water is not known since he fell below deck level and out of camera range. However, since he was moving forward at 67 kt at the time of ejection and since there would have been some deceleration due to wind resistance, naval officers who viewed the film and who are familiar with the ejection system stated that water impact under the conditions existing at the time of the accident would not have caused serious injury even without a parachute.—Ed.)

I don't know who will be voted "Man of the Year" in Time this year, but I cast my vote right now for "Quickest Thinking, Quickest Acting Man in the Navy" on the basis of AVIATION WEEK'S 1961 coverage.

His name is Lt. (jg.) John I. Krwan, whose picture sequence getting out of his F8U on a Roosevelt carrier landing you presented in your Dec. 25 issue (pp. 76, 77).

I go one further. I vote for this double spread as your most dramatic all time sequence, and I am proud to be an American when I see it.

Our boy Krwan will be very, very hard to beat if Khrushchev finally shoves us off into a war.

My hat is off to you, Lt. Krwan!

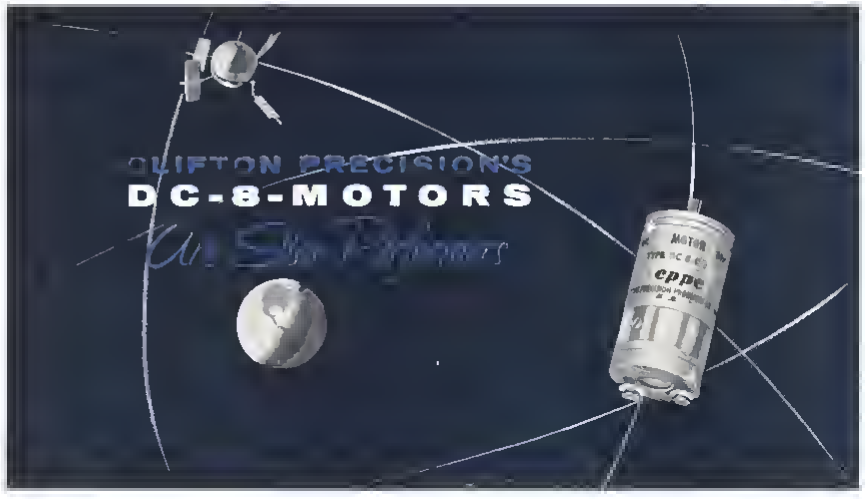
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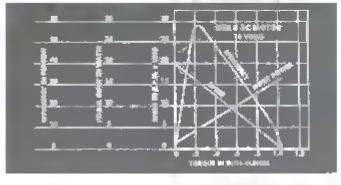
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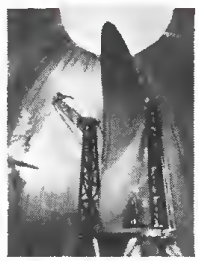
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